THE INSTITUTION OF PRODUCTION ENGINEERS JOURNAL

THE INSTITUTION OF

PRODUCTION ENGINEERS JOURNAL

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CONTENTS

HER MAJESTY QUEEN ELIZABETH II 253

THE WORK OF THE A.I.D. TEST HOUSE AND TECHNIQUES FOR MAINTAINING PRODUCTION QUALITY, by W. N. Blacklock, D.S.M., D.F.M., A.F.R.Ae.S. 256

THE MANUFACTURE OF COMPONENTS FROM POWDERED METALS, by W. D. Jones, Ph.D., M.Eng., F.I.M. 271

THE SODIUM HYDRIDE PROCESS—A NEW METHOD OF DESCALING METALS, by N. L. Evans, B.Sc., F.R.I.C., F.I.M. 280

THE ELECTRON MICROSCOPE, by M. Venner, B.Sc.(Eng.), A.M.I.E.E., M.Amer.I.E.E. 281

THE BRITISH PRODUCTIVITY COUNCIL 282

REPORT OF THE MEETING OF COUNCIL 284

ELECTION OF MEMBERS 286

EXTRACTS FROM LOCAL SECTION REPORTS 287

INSTITUTION NOTES 291

NEWS OF MEMBERS 292

NEW APPOINTMENTS 292

HAZLETON MEMORIAL LIBRARY 293

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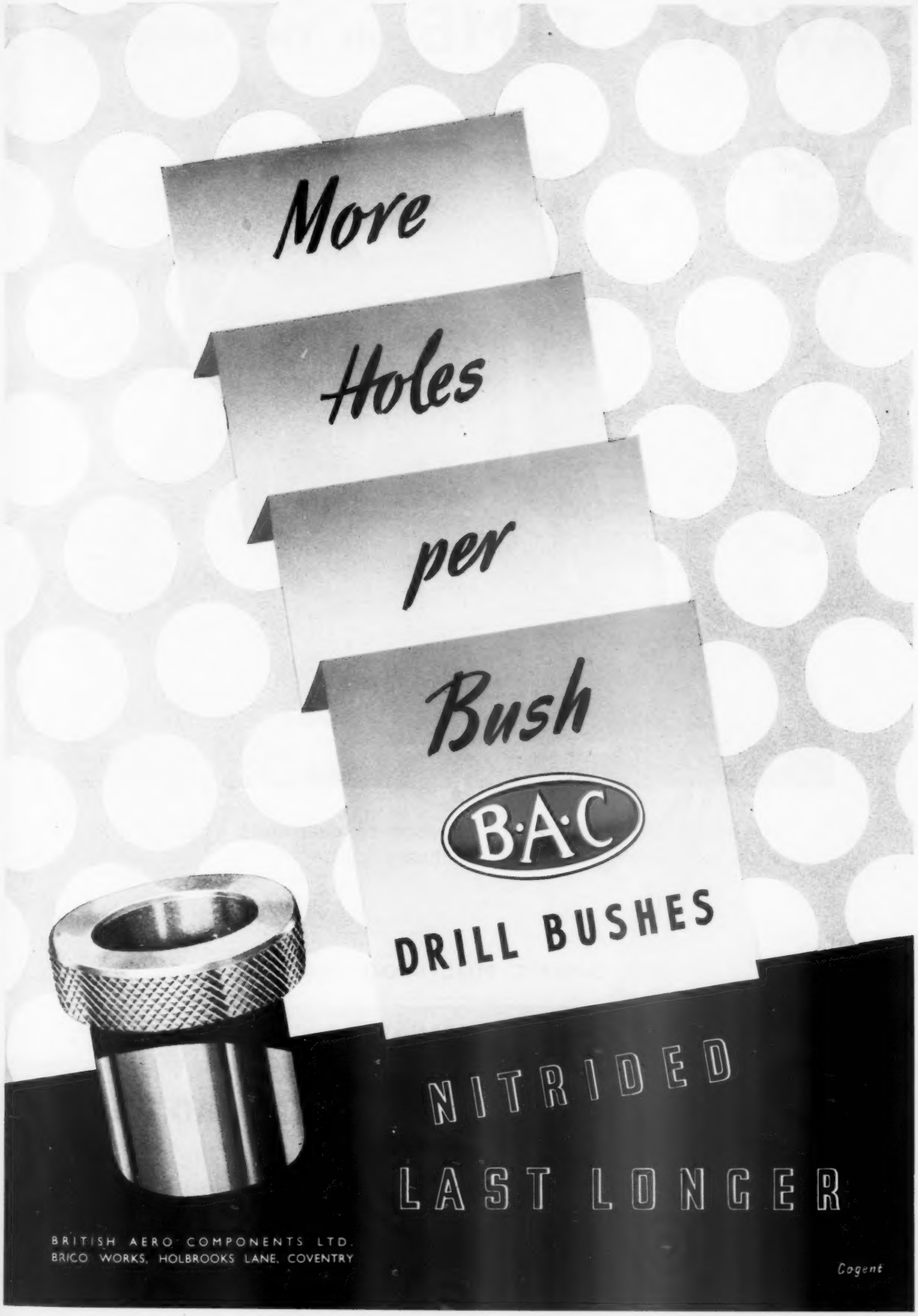
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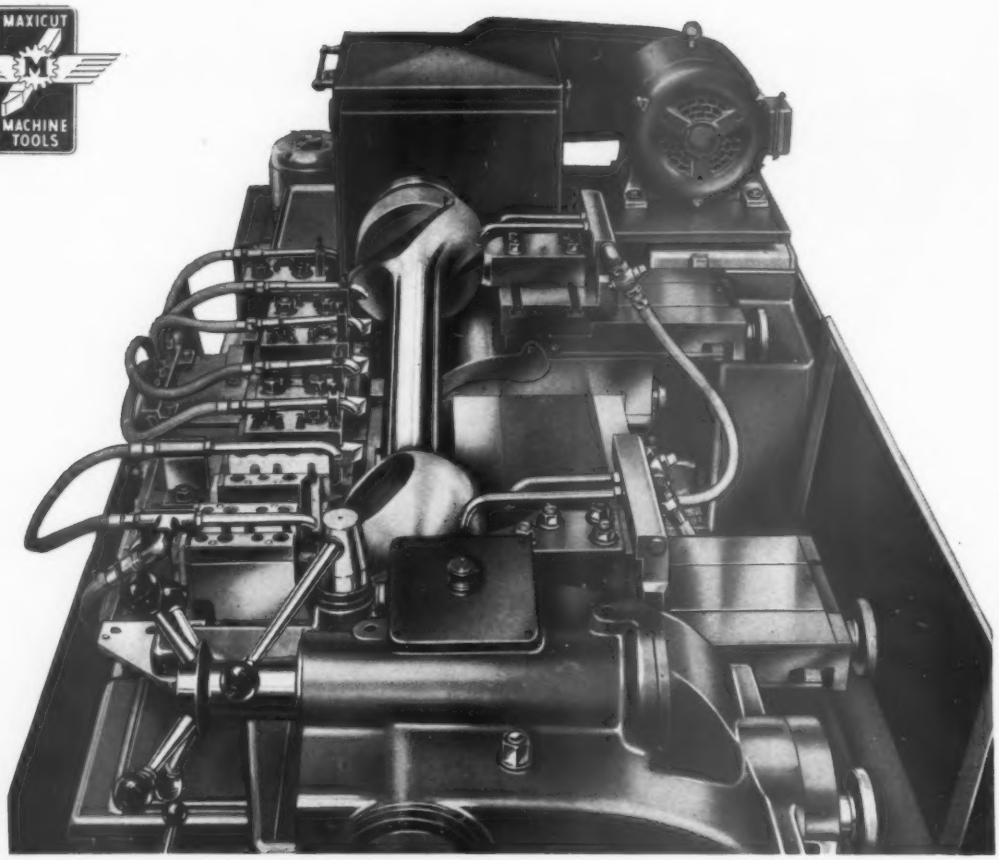

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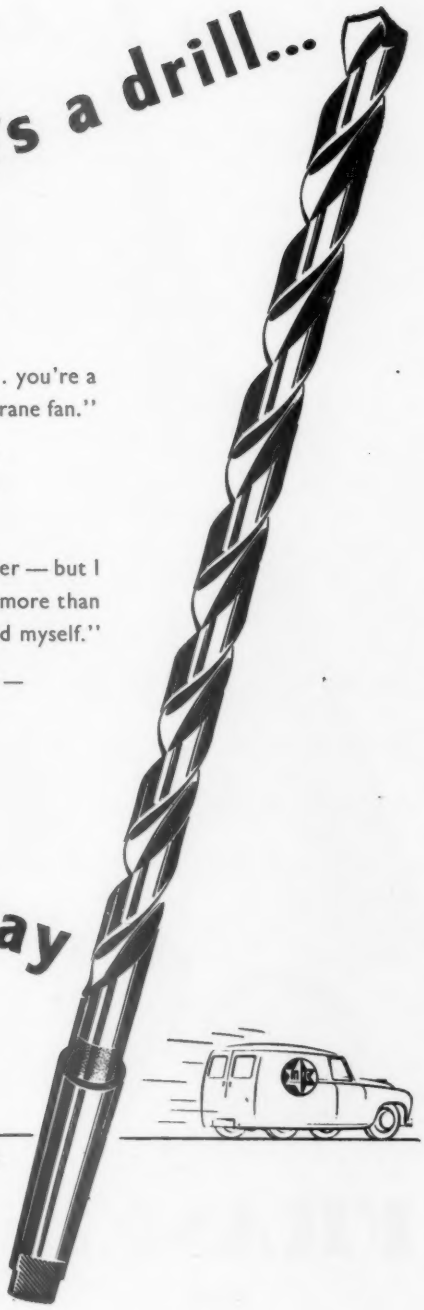

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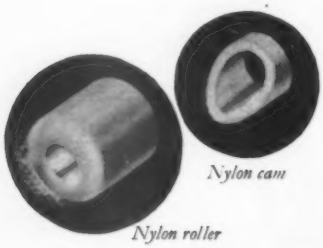
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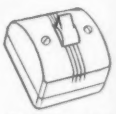
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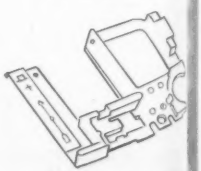
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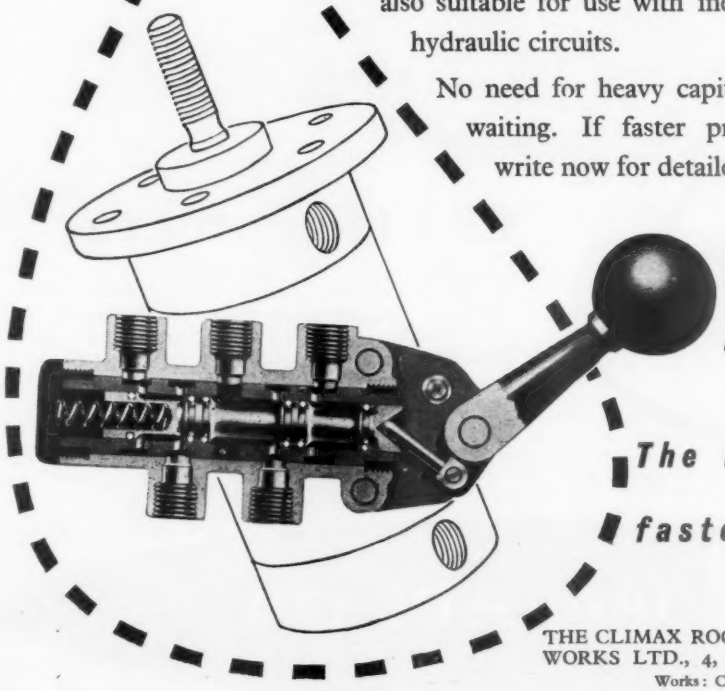

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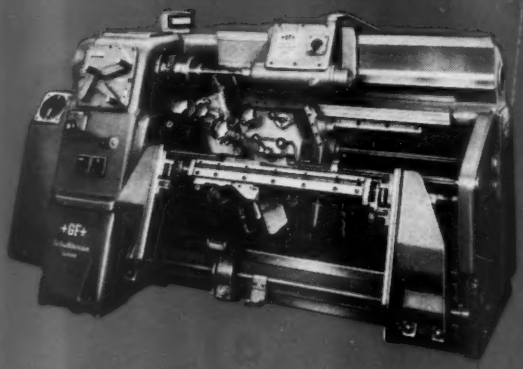

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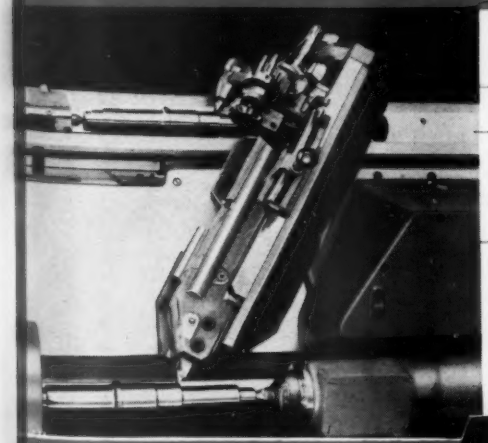

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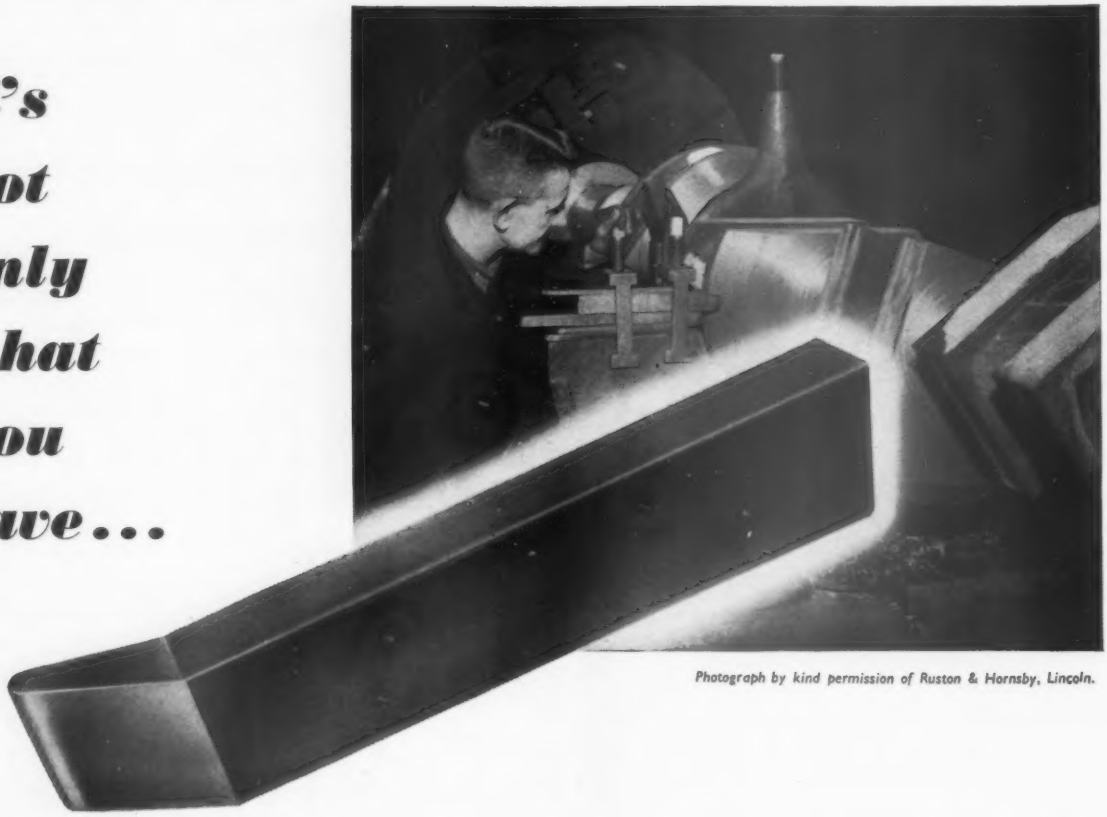

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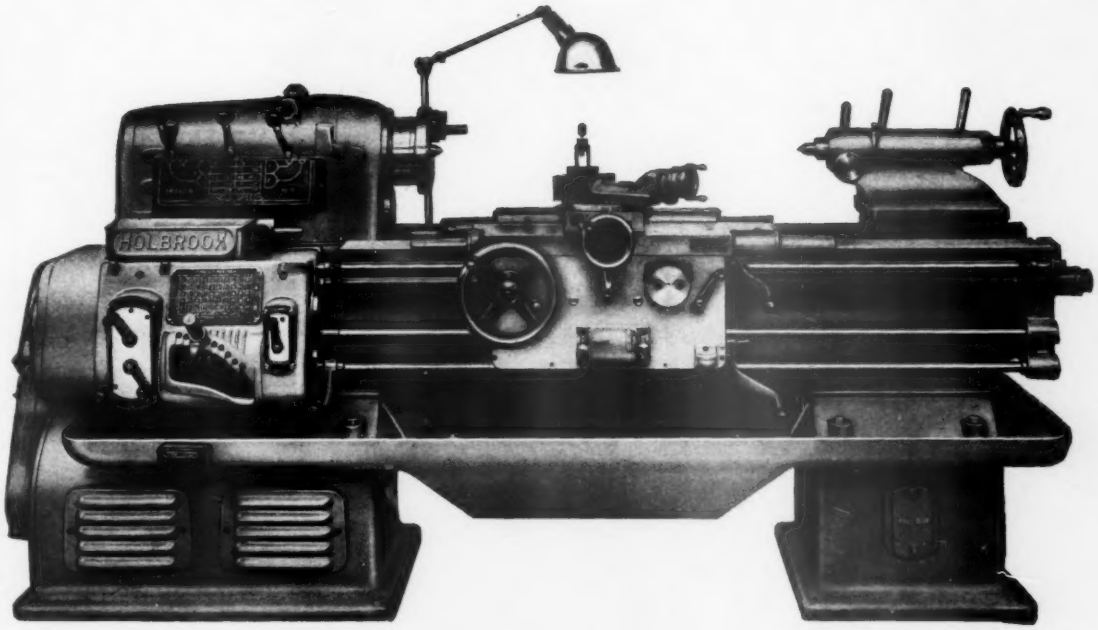

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Defender of the Faith

The Institution of Production Engineers Journal

VOL. 32 NO. 6 JUNE, 1953

IN presenting their loyal greetings to Her Majesty The Queen on the occasion of Her Coronation, the President, Council and members of the Institution of Production Engineers in the United Kingdom combine with their fellow-members in the overseas Sections of the Institution to declare their steadfast devotion to the Crown, and to offer their earnest prayers that Her Majesty's Reign will be one of peace, prosperity and happiness.

They assure Her Majesty of the continuance and extension of their wholehearted efforts to work for the good of Her Majesty's Realm and the industrial efficiency and high productivity so vital to the well-being of the peoples of this nation and the Commonwealth, and so essential to the peaceful progress of the world.

From Australia

The President, Sub-Council and members of the Institution in Australia, in offering their loyal greetings to Her Majesty Queen Elizabeth on this historic occasion, declare their continued devotion and service to the Crown.

It is their earnest hope that Her Majesty's Reign will be a long and happy one and will be blessed with peace and prosperity throughout the world.

From Canada

With the Coronation of our beloved Queen, Elizabeth II, our thoughts are directed towards the underlying principles of democracy and self-determination which bind together the British Commonwealth.

We, the Canadian Section of the Institution of Production Engineers, in this short message wish to convey to Her Majesty our deep-seated loyalty, so fundamental to these principles. It is our fervent wish that during Her Reign the invisible links between the Crown and the Commonwealth may grow even stronger and our comity of nations be a shining example of unselfish achievement and progresss.

From India

On this happy and auspicious occasion of the Coronation of Her Majesty Queen Elizabeth II, on behalf of the members of the Institution of Production Engineers in the Calcutta and Bombay Sections, we offer our sincere greetings and felicitations.

As members of the British Commonwealth of Nations, we are happy to have this opportunity of wishing Her Majesty long life, great happiness, and peace and prosperity for all nations of the world during Her Reign.

From South Africa

May it please Your Majesty to accept from us, the President, Sub-Council and members of the South African Branch of the Institution of Production Engineers, our humble and loyal greetings and felicitations on this, the historic occasion of Your Majesty's Coronation as Supreme Head of the British Commonwealth of Nations and your devoted subjects in this country.

We pray that God will sustain and strengthen Your Majesty in the arduous duties before you and that Your Majesty's Reign may be signally illustrious, happy and truly great.

From New Zealand

On the occasion of the Coronation of Her Gracious Majesty, Queen Elizabeth II, the members of the New Zealand Section of the Institution of Production Engineers reaffirm their loyalty to the Crown.

We invoke the blessing and aid of the Almighty that peace and prosperity in the world and unity within the Commonwealth will prevail during Her Gracious Reign.

GOD SAVE THE QUEEN

Photograph by Dorothy Wilding

THE WORK OF THE A.I.D. TEST HOUSE AND TECHNIQUES FOR MAINTAINING PRODUCTION QUALITY

by W. N. BLACKLOCK, D.S.M., D.F.M., A.F.R.Ae.S.

Presented to the Manchester Section of the Institution, 20th October, 1952.

Mr. W. N. Blacklock

After early engineering training at Sunderland, Mr. Blacklock joined the Royal Naval Air Service and took part in the construction and service operation of flying boats, including the famous F.5's and the Felixstowe Fury. Following the First World War, he took up a technical advisory post with the Spanish Naval Air Service, and later joined the Bristol Aeroplane Company, working under Sir Roy Feddon on the development of Bristol Jupiter supercharged engines.

In 1928, he joined the Air Ministry (Aeronautical Inspection Directorate), and served at various firms as Inspector-in-charge and representative of the Directorate of Technical Development. Immediately prior to the Second World War, he visited the U.S.A. to review inspection organisations at works engaged on production of aircraft for the Royal Air Force.

Subsequently, Mr. Blacklock was appointed Senior Inspection Officer (Engines) and later, Deputy Principal Inspection Officer in the North Western Area. He has been Superintendent of the A.I.D. Test House at Harefield since 1946.

BEFORE discussing the work of the A.I.D. Test House and some of its techniques developed to maintain and improve production quality, a brief general history of the A.I.D. since its inception may be of interest.

The primary function of the A.I.D. is to secure that all equipment and supplies ordered or services performed, subject by the conditions of contract to inspection to the satisfaction of the Director of Aeronautical Inspection (D.A.I.), are in conformity with the stipulated requirements, and are in every way fit for H.M. Service.

D.A.I. is responsible for the inspection of all equipment, subject to Ministry of Supply (M.O.S.) contract for use by the Royal Navy and the Royal Air Force during development, manufacture, modification or repair. He is also responsible for the inspection during manufacture of those civil aircraft supplied against M.O.S. contracts.

The First Contracts

During the year 1912 the first aeroplane contracts, placed by the Director General of Military Aeronautics, War Office, on private firms, were issued, and it was stipulated that an inspection similar to that in operation at the Royal Aircraft Factory should be introduced on all such contracts under the direction of the Royal Aircraft Factory Inspection Department itself. After a short time, however, it was considered desirable that an entirely separate organisation should be set up, having for its sole purpose the inspection of all aeronautical equipment purchased for the use of the R.F.C. Eventually, in December, 1913, the Aeronautical Inspection Department came into being, the position of Chief Inspector being allotted to Major J. D. B. Fulton, R.F.A., one of the earliest members of the original Army Air Battalion—the predecessor of the R.F.C.

Within a period of two months from its inception, the main organisation of the Department was established to cope with the work then foreseen, and inspection at Contractors' Works, which up to then had been undertaken by the Royal Aircraft Factory Inspection Department, was assumed by the A.I.D. in February, 1914, a date which may be regarded as the starting point of the useful life of the Department. At this date, the total technical establishment of the A.I.D was 24.

During 1915 the aircraft industry and the work of the R.F.C. in the field developed very rapidly, and the system of inspection was developed in detail from the experience gradually gained as to the sources of

possible failure, delay and wastage of material, of which at that time there was an acute shortage. It was further realised, from this experience, that inspection of materials was of most vital importance, being the basis of all inspection and that in its inspection the suitability of the material for its destined service in the aeroplane or engines was the chief factor to be considered. A small but complete Test House for the testing of materials had already been developed at Farnborough.

The growing number of resident A.I.D. Stations and the local knowledge as to the condition of labour and existing work in the provinces, was placed at the disposal of the Chief Contracts Officer, to assist him in introducing new firms to aircraft work. Before new firms were given aircraft or engine contracts, a technical report by the A.I.D. was first required as to the general class of workmanship and working efficiency which might be expected.

Decentralisation

It became necessary to decentralise control into District Organisations, since it was found to be quite impossible for Central H.Q.s to keep in immediate touch with the ever-changing conditions of affairs in the Contractors' Works, as was demanded if the output was not to be held up awaiting definite technical decisions in the way of concessions, etc.

By this time the staff had increased considerably, and it was at this period that the extensive use of Female Viewers was first developed, having been originated by the A.I.D. in 1915 at the Ordnance Aircraft Department Stores, Farnborough. It may be claimed for the A.I.D. that, to a large degree, it was the pioneer of inspection by women. Indeed, from this time onwards throughout the war, not less than 50% of the whole A.I.D. staff were women. The bulk of their work was confined to detailed viewing "to drawing", no discretion for the acceptance of parts outside the drawing dimensions being allowed. This function was exercised by the Male Examiner in charge of the View Room, who further periodically checked the work of the Viewers and particularly the parts rejected by them.

Release Notes and Test Reports

In order to reduce, as far as possible, the volume of inspection at the main Contractor's Works, and to

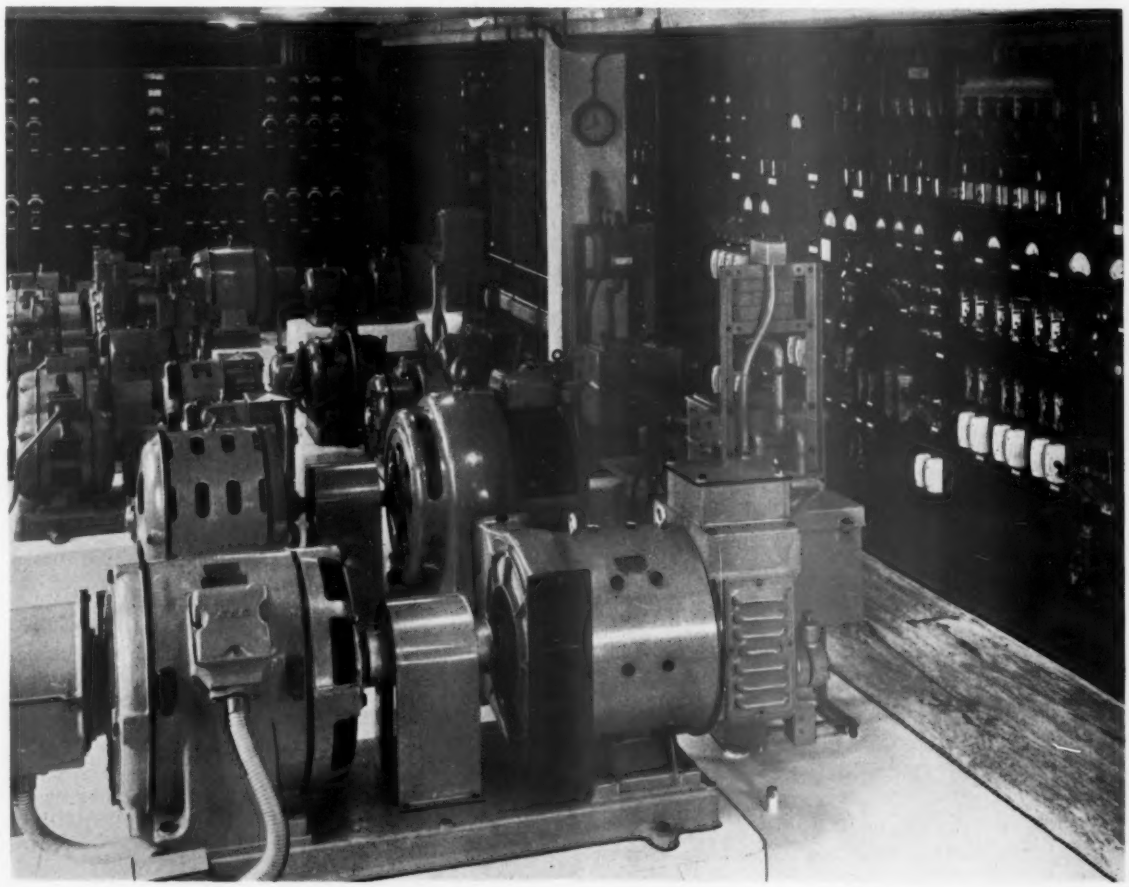

Fig. 1. Generator Hall.

prevent wastage of material, etc., A.I.D. inspection was instituted at firms producing material or components on sub-contract orders for the main Contractor. At the same time, a system of release notes was inaugurated whereby all consignments of approved parts delivered by a sub-contractor to a main Contractor were accompanied by a voucher identifying the consignment with its approval, so that, on arrival at the main Contractor's Works, the resident Examiner was able to pass the whole consignment into the Firm's stores without re-examination, apart from a superficial inspection to see that the goods had not suffered damage or deterioration in transit. At the steel makers, reports embodying the results of physical tests and chemical analysis obtained on each consignment of materials were dispatched with the release notes. This gave valuable assistance and information to the main Contractor as to the particular care and procedure involved in the heat treatment of the newly introduced alloy steels. These Test Reports further embodied details of heat treatment advocated by the steel maker in conjunction with the A.I.D., to obtain in the heat treatment and completion of the metal fittings, the required physical qualities.

During 1917 the intense activity in aircraft manufacture, which came as a result of the increased Service demands for aircraft, fostered by a more adequate appreciation on the part of the country as to the strategic possibilities of aircraft (brought home to it by enemy raids on London) made it impossible for the A.I.D. to continue its system of full detailed inspection. Recourse had, therefore, to be made to a system of " selective " inspection, whereby the whole output of a firm was inspected in detail by the Contractor's own viewing staff, and only a proportion of that output was re-examined by the A.I.D. who, however, supervised the firm's methods of inspection and required fulfilment of certain standard conditions; such as, for instance, the individual identification of every detail with the firm's viewer, responsible for its inspection.

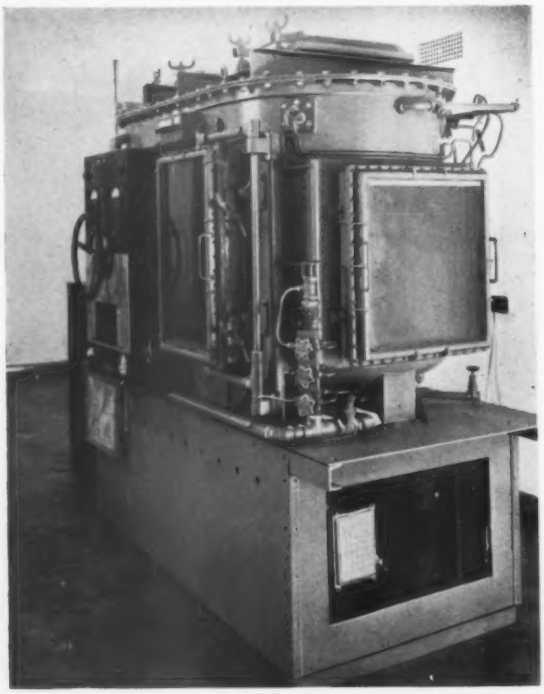

Fig. 2
Low Pressure and Low Temperature Chamber.

Introduction of Selective Inspection

Selective inspection, when once introduced at a Contractor's Works, was as a rule maintained to the same extent throughout all his succeeding contracts, save that on the introduction of contracts for new types, a complete detailed inspection was carried out by the A.I.D. on the first, say, 10-15 aeroplanes or engines, to ensure that the essential points as regards dimensions, finish, etc., which differ in every new type, were receiving the necessary care in the firm's View Room; also to ensure that faults in jigging and method of manufacture were discovered and traced to their origin before bulk production started.

After the 1918 Armistice, the great inspection machinery built up laboriously during the war was gradually slowed, the staff of the A.I.D being steadily decreased as the contracts were stopped or completed.

During the years following, the A.I.D. system of Approved Firms' inspection was applied and developed, and amply proved its practical value, especially during the stringent production expansion years of the 1939/1945 war.

The success of this system, as applied and developed by the A.I.D., depends upon the careful investigation of manufacturing firms' inspection facilities and personnel prior to official approval and, subsequently, the application of adequate supervision in the firms' works. This requires that the inspection staff in the field have an authoritative and reliable organisation behind them to which they can refer in all instances of doubt and controversy.

Establishment of A.I.D. Test House

Appreciation of the fundamental need for energetic and progressive inspection development demands efficiently equipped laboratories staffed by qualified personnel, in order that inspection shall always be ready with appropriate and economical inspection methods. Hence the provision of the A.I.D. Test House Establishment at Harefield, developed through several stages from the early Farnborough days, the primary functions of which organisation are now :—

The repository of appropriate standards and substandards, defined and maintained to a high degree of accuracy and efficiency, for all relevant activities of the A.I.D. An authoritative consultative body with experimental facilities enabling it to advise and adjudicate upon current inspection problems in all the appropriate technical branches.

Development work on inspection problems for the evolution of new methods of inspection and the

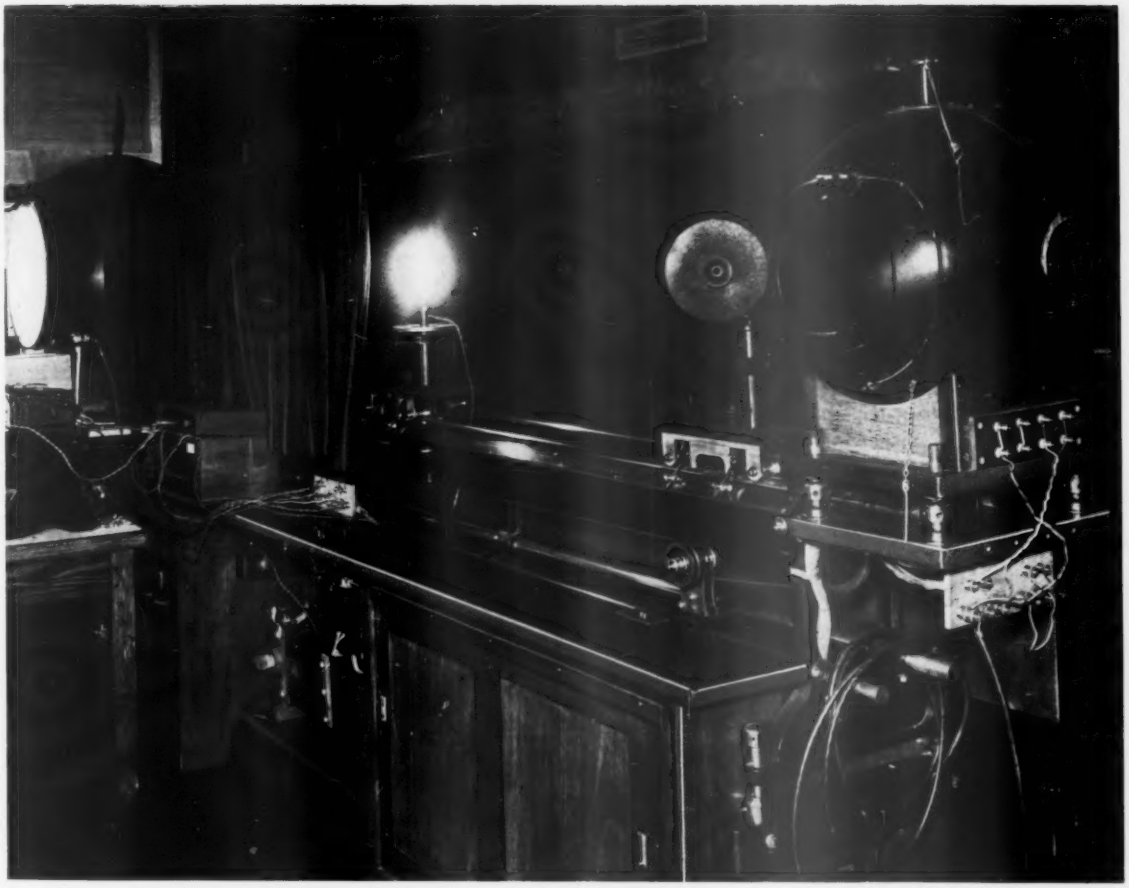

Fig. 3. Photometer Bench.

modifying of existing ones; constant and systematic liaison with current scientific research and with industry.

The A.I.D. Test House organisation is arranged in seven main Sections covering Metallurgy, Metrology, Chemistry, Physics, Radio and Electricity, Non-Destructive Testing, and Administration.

In addition, workshops are provided for the manufacture of intricate master reference gauges, test pieces, prototype instruments, test rigs, and the normal maintenance of the Establishment.

Air in the main building is controlled to 60°—68°F. Laboratories dealing with metrology, instruments, textiles and electrical standards are controlled to 68° ±1°F. where necessary to the work. The Textile Testing Laboratory is also controlled to 65% ±1% R.H.

Current is taken into the Generator Hall (Fig. 1) at 415 V. 3 ph. from the 6,600 V. grid *via* a transformer sub-station. It is then converted to other values required for tests, in the various laboratories. These include 2,500 D.C., 1,200 D.C., 210 D.C., 110 D.C., 2 V. to 60 V. x 500 A.H., 260 V. x 100 A.H., 10 V. to 1,600 x 300 M.A. Batteries. A 50 cycle sine wave alternator driven by a 6 K.V.A. motor is used for supplying a 100,000 V. transformer, located in the High Voltage Test Laboratory. The alternator can be controlled from this Laboratory, enabling tests up to 10,000 V. D.C., and 100,000 V. A.C. (50 c/s) to be carried out on various materials and components, while in the Low Pressure and Low Temperature Chamber (Fig. 2), the performance of instruments, radio equipment, components, materials, etc., can be ascertained at temperatures from +80°C. to -70°C. and pressures equivalent to altitude conditions up to 70,000 feet.

Instrument Testing Laboratory

Here, precision manometers and sub-standard Kew type barometers are used for testing the calibration accuracy of air speed indicators, machmeters, altimeters and rate of climb indicators. These instruments are checked under the varying conditions encountered in flight. Subsidiary test equipment in the form of altitude chambers, refrigerators, ovens and vibration tables are available together with appropriate electrical services, pressure and vacuum lines. Other Instrument Laboratories are equipped

to test a wide range of gyroscopic instruments and specialised navigational aids.

The apparatus for carrying out Engine Speed Indicator Tests accommodates the original mechanised types of engine speed indicator and the current range of electrical tachometers, both indicators and generators. This apparatus embodies a drum type stroboscope with slots, holes and tuning fork control. A variable speed motor with gear box and controls enables the instrument under test to be calibrated at suitable intervals over its entire range.

The photometer bench (Fig. 3) is used for measuring the candle power of electric lamps embodied in aircraft landing and navigation lights, etc. Measurement is by comparison with standard lamps calibrated by the N.P.L. and accurate measurement of voltage and power consumption is made with the potentiometer.

Mechanical Testing

In the Mechanical Test Laboratory, tensile, compression and shear tests are performed on standard universal testing machines. A full range of extensometers is available for the determination of Young's Modulus, Limit of Proportionality, Proof Stress, and Yield Point. For greater precision, use is made of highly accurate Lamb roller extensometers. Extensometers have also been developed for the determination of extension up to the point of fracture; 5, 10, 30 and 50 ton tensile testers, Extensometer Comparator, Izod Impact Tester and Hardness Testers are used in this Laboratory.

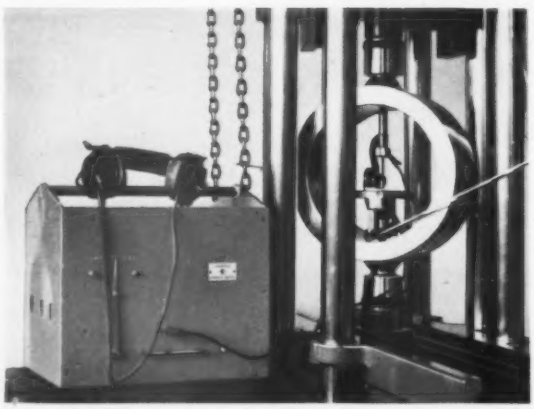

Fig. 4. Calibration of Testing Machine.

Fig. 4 shows a 50-ton proving ring set up to calibrate, in compression, the 30-ton testing machine. Included is an electric oscillator which drives the indicating reed at a constant speed. The ring is capable of measuring accurately, deflections caused by loads as low as 20 lb., i.e. a sensitivity of better than 1 lb. in 5,000.

The Micro-hardness Testing Machine shown in Fig. 5 is capable of providing impressions with loads ranging from 25 to 3,000 grms. and can be used for testing plating, hard surface layers, nitriding, carburising and constituents of microstructure; hard particles of only 0.0004″ can also be tested. The microscope has a x 750 magnification in order to see and measure the small impressions.

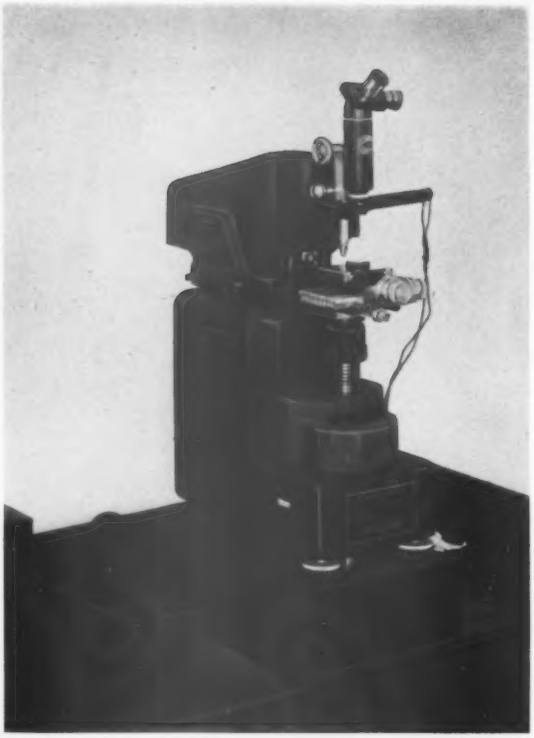

Fig. 5. Micro-hardness Testing Machine.

The hardness impressions illustrated in Fig. 6 were made on the micro-hardness testing machine. The impressions were made with a load of 50 grms. and are spaced at 0.0008″ intervals. The impressions are over a cross-sectioned sample of 0.002″ thick chromium plate.

Fig. 7 shows Lamb's Roller Extensometer. This particular extensometer has a 1″ gauge length and is

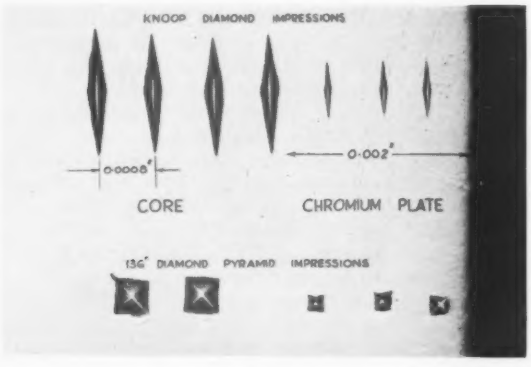

Fig. 6
Diamond Pyramid and Knoop Hardness Impressions.

mounted on a sub-standard test sample set up to give an extension magnification of 10,000 to 1.

As the specimen extends, the two rollers mounted between the two sets of knife edge carrying plates rotate with their mirrors, giving an apparent scale movement to the observer looking through the telescope.

The rig shown in Fig. 8 is set up to check an Electrical Autographic Recording Extensometer. With this set-up, the actual extensometer mounted on the comparator and the indicated extension shown on the recording drum are calibrated simultaneously. Settings are made on the comparator by insertion of Johansson slips and the variation in extension is noted on the extensometer recording drum.

A standard Vertical Comparator is pictured in Fig. 9. As shown, two anvils and a push rod are the only parts specially made to adapt this vertical comparator for the purpose of calibrating extensometers. A micrometer drum is used only for applying smooth movements to the extensometer *via* the push rod. The drum is turned to set a predetermined number of dial divisions on the extensometer for comparison with the actual extensions shown on the comparator, where readings of .00001" can be obtained. It is possible to calibrate an extensometer of the standard type shown at points over its complete range in under 30 minutes.

The apparatus shown in Fig. 10 is used mainly for mechanical testing of materials used in gas turbines. For creep testing at temperatures up to 1000°C., furnaces are controlled to exceptionally close limits of temperature. Extension of the test piece is measured to .00001" by optical method.

Creep Testing

The machine in Fig. 11 was designed and constructed to demonstrate the creep phenomena of metals to Inspectors attending courses of instruction. The load can be adjusted to give varying creep rates to lead specimens at room temperature.

Fig. 12 gives creep curves constructed from data obtained on the creep testing demonstration machine. These curves illustrate the three stages of creep, primary, secondary and tertiary, and are similar in

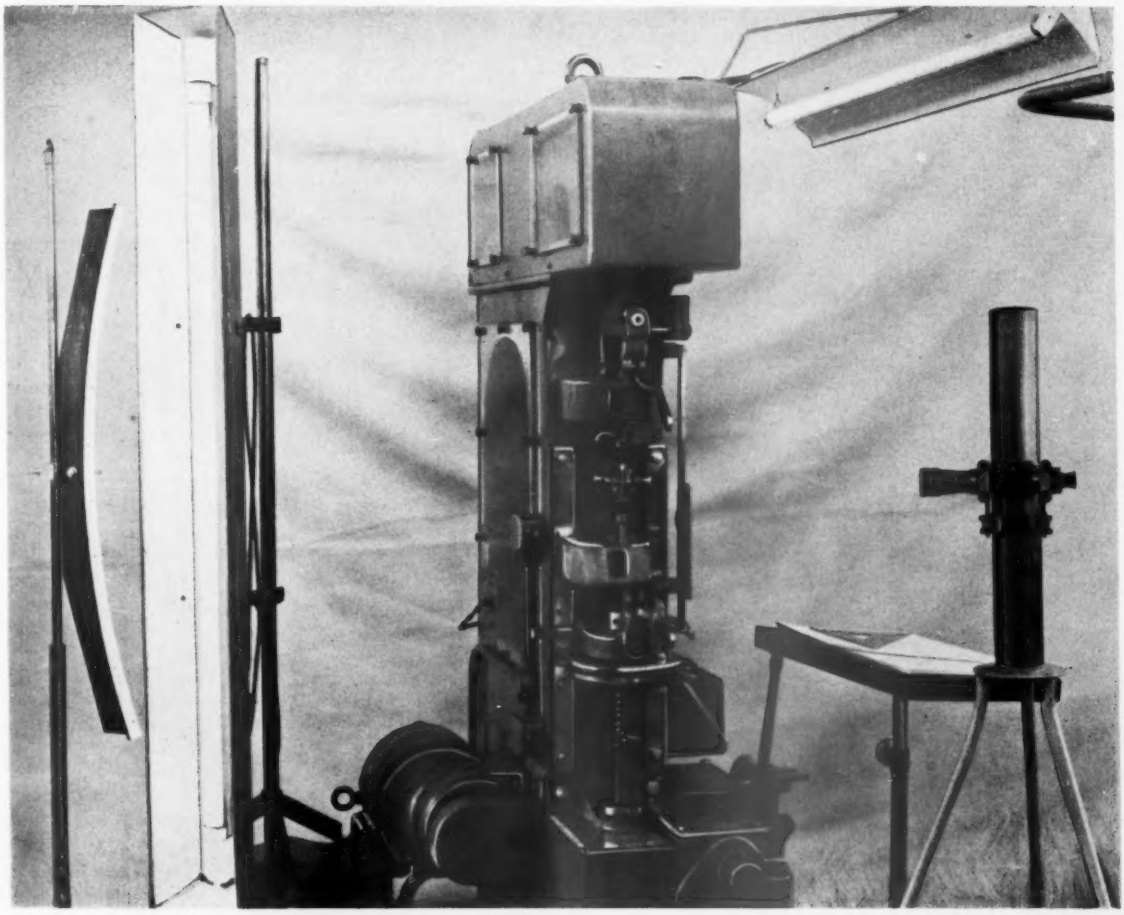

Fig. 7. Lamb's Roller Extensometer.

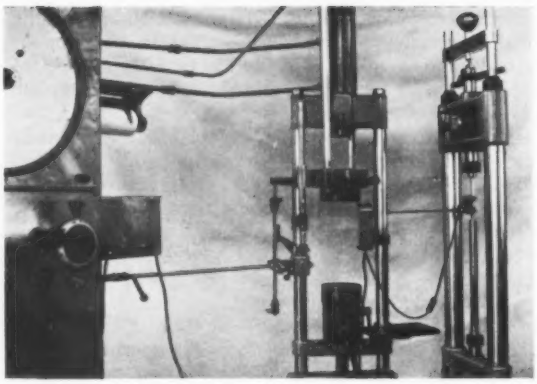

Fig. 8. Rig for calibrating Extensometer.

form to the curves obtained on full scale tests at high temperatures.

The Metallography Laboratory contains a full range of microscopes and facilities for examining microstructures of metals and alloys at magnifications up to x 4000, and is used for investigation of failures and defects on aircraft and engine parts; the quality and conditions of ferrous and non-ferrous materials in the cast and wrought forms; overheating, burning, surface hardening and corrosion problems; maintenance of standards for the assessment of welded and brazed joints.

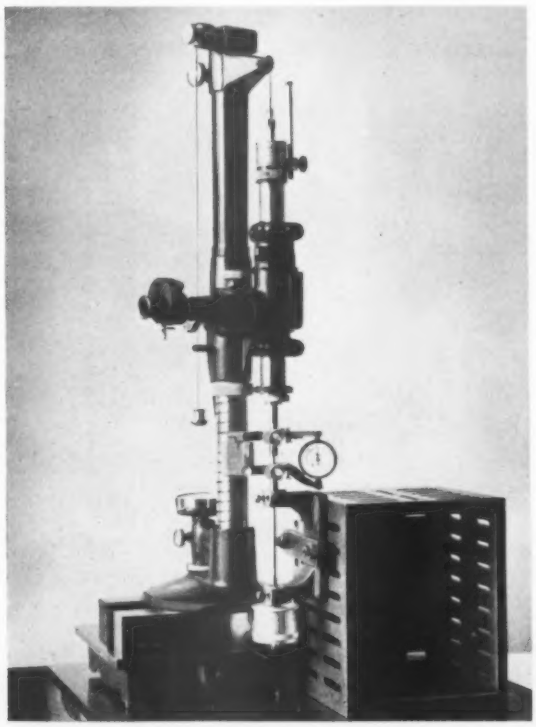

Fig. 9
Standard Vertical Comparator adapted to calibrate Extensometers.

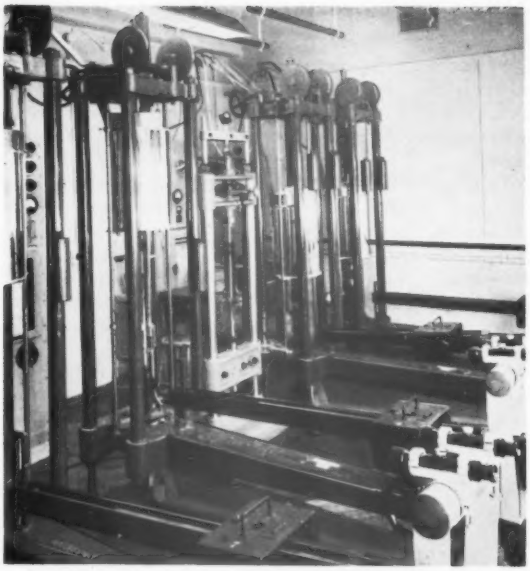

Fig. 10. High temperature materials testing.

Approved Test Houses

The standard specimens used for checks on A.I.D. approved Test Houses are prepared by the A.I.D. Test House; the acting length of these specimens is ground to an accuracy of $\pm 0.0002''$ and to a surface finish of 20 micro-inches. These specimens are forwarded to the approved Test Houses periodically for the determination of 0.1% Proof Stress, Ultimate Tensile Stress and Modulus of Elasticity. The results of these tests are returned to the Test House for comparison with the values obtained in contiguous specimens and accuracy within $\pm 2\frac{1}{2}\%$ is expected. Errors in excess of these are carefully investigated by the supervising A.I.D. Inspector.

X-Ray Diffraction

X-Ray diffraction is used to great advantage on investigatory work on the identification and analysis of chemical substances and corrosion products. Established techniques are employed for the determination of grain size and grain orientation, the effects of heat treatment and internal stresses in aircraft materials. Metallographic work on these materials and on the high temperature metals, is supplemented by detailed examination of their constitution and structure. A fine X-Ray beam of approximately 40 to 50 K.V. is directed on to the specimen, which is placed in the centre of a camera of 9 centimetres diameter and diffracted on to a film placed circumferentially about the specimen. The diffraction patterns recorded by the film are measured and referred to standard data for composition or condition.

The patterns shown in Fig. 13 demonstrate a

useful application of the technique. They relate to an investigation into the failure of an aircraft during take-off, owing to a small fragment of metal becoming lodged in the engine fuel control valve. Within a few hours of receiving the fragment of metal and details of the failure, the A.I.D. Test House established that the composition of the metal was to Specification L.33. From this information, the investigators were enabled to trace the actual casting from which the fragment had been dislodged.

Radiology

Radiology is taking a prominent part in maintaining the quality of casting production. X-Rays are produced by placing a high potential across the tube so that the anode is positive and the filament negative. This causes electrons from the heated filament to bombard a controlled area on part of the anode called the target. The impact of the electrons on the target causes them to give up their Kinetic energy which is transformed into heat and light (99%) and X-rays (1%). A high voltage across the tube will give the X-rays greater penetrating power than a low voltage. Control of this voltage, also of filament voltage, provides the operator with adjustments which he varies to suit the work to be radiographed.

It is a design requirement that all airframe castings in Classes 1 and 2 and certain turbine engine castings shall be radiologically examined. A Class 1 part is defined as one whose failure in flight, landing or take-off might be the direct cause of structural collapse, loss of control, failure of motive power,

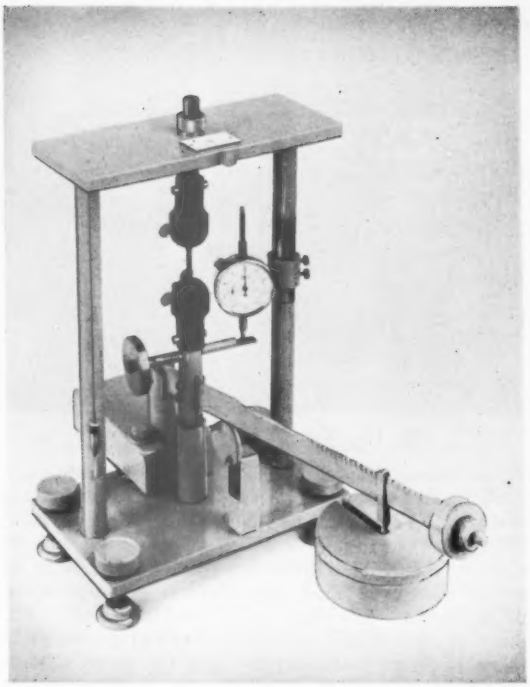

Fig. 11. Creep testing demonstration model.

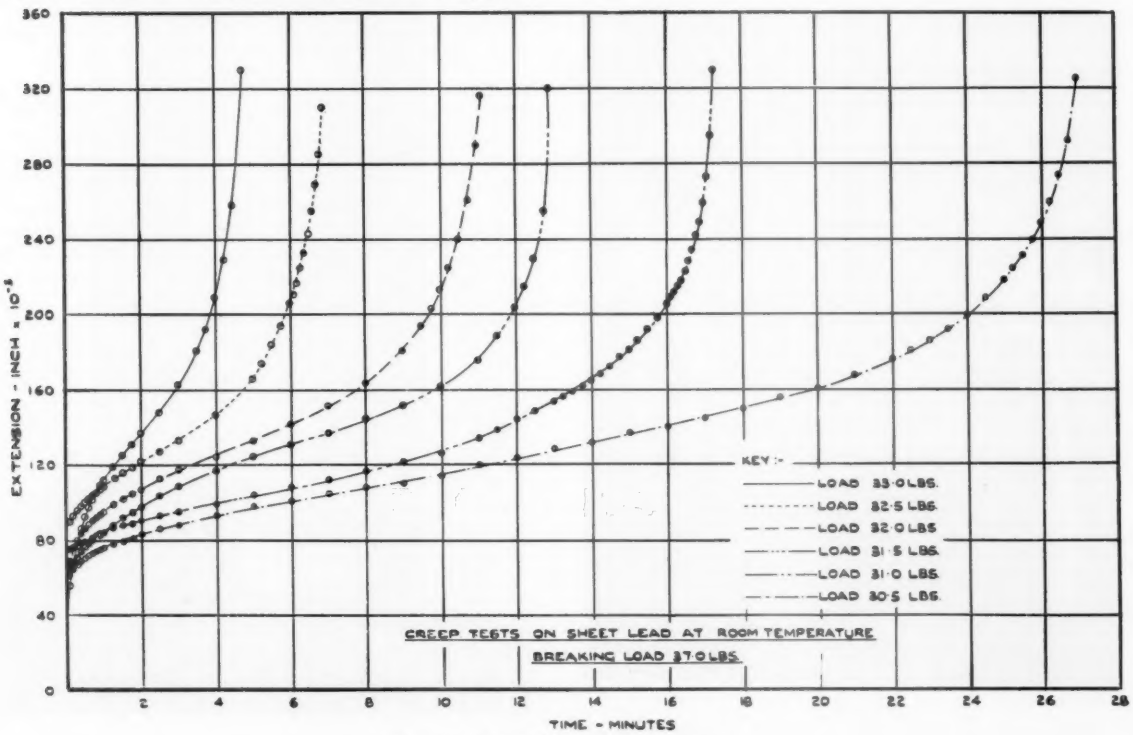

Fig. 12 Creep Demonstration Curves.

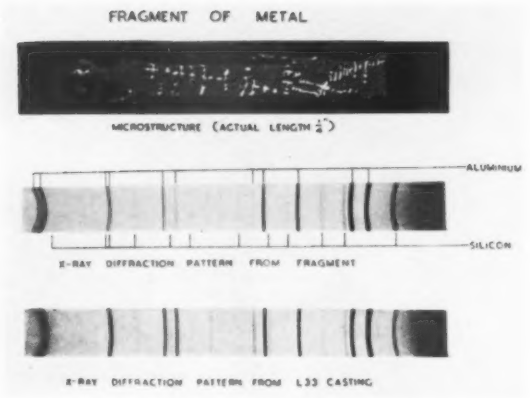

Fig. 13. X-ray Diffraction Patterns.

unintentional release of or inability to operate guns, rockets, etc., or undercarriage. A Class 2 part is defined as a stressed part not covered by the terms of Class 1.

With the Million Volt Set shown in Fig. 15, internal defects in steel castings and forgings up to 6″ thick can be radiographed and detected. The angle at which this particular radiograph is to be taken is clearly demonstrated and the metal cassette containing the X-Ray film can be seen under the casting. The set is mobile in all directions within the Laboratory, and cannot be operated until doors

Fig. 14
Radiograph of aircraft control fitting, showing material defect.

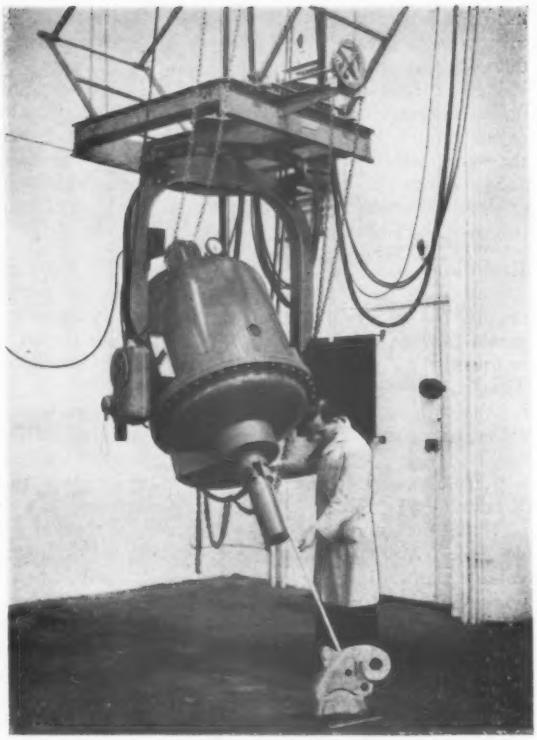

Fig. 15
Lining up casting for radiography, using 1,000,000 volt X-ray apparatus.

leading to the separate control rooms are closed. Closing the door operates a siren to warn any personnel remaining in the Laboratory to depart. All staff engaged on radiological work carry pocket dosemeters from which daily readings are recorded, so that the permitted individual weekly dosage of X-Rays is not exceeded. Periodical medical examinations are carried out and special precautions have been taken in the construction of the Laboratories to

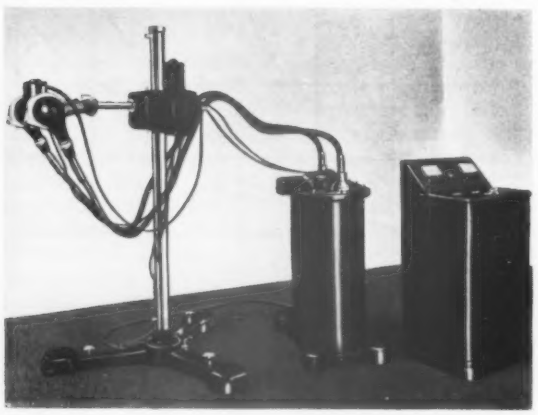

Fig. 16. 140 kV X-ray Unit.

reduce X-Ray penetration of walls, etc. Radiological techniques are developed in special cases and firms' radiologists seeking A.I.D. approval are examined in both theoretical and practical radiology.

The unit shown in Fig. 16 is capable of X-Ray examination of aluminium castings up to 3″ thick. It is also possible to examine radar valves, plastic mouldings, welded structures, etc. Castings up to 2″ thick and some types of assembled components can be examined by the use of the fluoroscopic method.

In the radiograph of a radio valve, the conductors, joints and other details can be seen. A break in the filament is also visible.

Use of Radio Isotopes

Radio isotopes can be used in certain cases to eliminate the necessity for costly X-Ray equipment. Cobalt and tanalum isotopes produced by pile irradiation at Harwell are popular for radiographing steel castings. These radio-active sources have half lives of five years and 120 days respectively, requiring exposures of many hours varying with power of source, distance and thickness of castings. To produce similar radiographs using X-rays would, of course, only take a few minutes. Experiments are proceeding in order to find a suitable isotope for radiographing light alloys.

Fig. 18 illustrates a technique for obtaining radiographs using gamma rays. A wood fixture is used to locate the isotope shown at C which is attached to rod A. The clip B is firmly fixed to A and rests on the wood platform, thus locating the position of the isotope in relation to the parts to be radiographed. The metal cassettes containing the films can be seen in position behind the parts. The end of A contains an internal screw thread into which the radiographer screws a rod 6′ or longer in length, to locate or remove the isotope in the wood fixture or its transportable lead container. This ensures that the radiographer can always remain at a safe distance from the radio-active source. The particular technique illustrated is carried out in a pit contained by concrete walls 18″ thick, the isotope being located or removed from a platform erected on top of the pit.

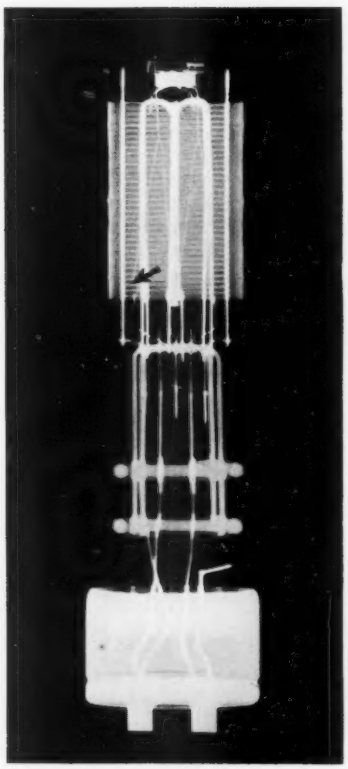

Fig. 17. Radiograph of a radio valve.

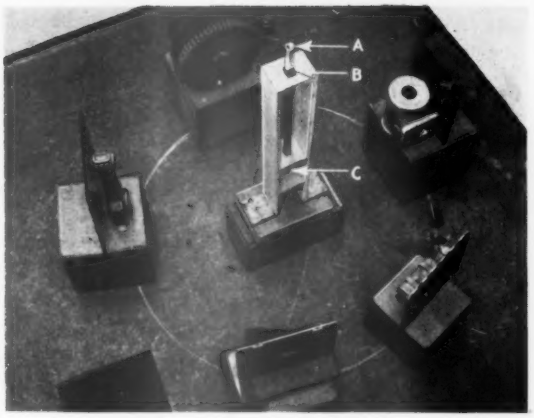

Fig. 18. Radiology of Gamma-rays.

Two blocks of lead comprise the body and lid of the container for radio-active sources (Fig. 19), which have holes in the centre of their masses. The sizes of the holes permit easy location and extraction of the source, also its handling rod. In this particular illustration, the radio-active source is radon which has been removed from its metal holder for demonstration purposes only. Radon sources are prepared by

Fig. 19. Container for radio-active sources.

absorbing the gas from radium on a small charcoal granule contained in a glass capsule. Radon can be used for the penetration of steel 2″ to 6″ thick, but its half life is only 3.8 days. By this method, it is possible to get a very highly concentrated source which gives good definition on the radiograph.

The store for radio-active isotopes consists of a solid block of concrete 14′ x 6′ 6″ x 6′ 6″, brick faced, containing four separate chambers fitted with 3″ thick lead doors. The chambers accommodate transportable containers with radio-active sources. Ventilation of the chambers is effected by an electrically driven fan to guard against any leakage of radio-active gas from the sources being stored. The source and its transportable container are pushed from the Laboratories into the chamber by means of the long rod, which can be easily removed before closing the lead door.

Fig. 20
Universal AC/DC electromagnetic crack detector.

Non-Destructive Testing

Detection of fine cracks and other surface and sub-surface defects which may act as local stress raisers is an essential part of inspection. Their detection in steel parts (except non-magnetic steels) is greatly facilitated by the employment of electro-magnetic methods. When a part is magnetised, magnetic poles occur at discontinuities such as cracks or inclusions. When particles of magnetic powder are sprinkled on the surface of the part, they are attracted to the poles, thereby indicating the location of the defect. In practice, the magnetic powder is suspended in a suitable liquid and is poured over the part while the latter is being magnetised.

There are two principal methods of magnetising the parts, one where the part is placed between the poles of a powerful electromagnet, and the other where a heavy current is passed through the part. The former is described as "Magnetic Flow", and the latter as "Current Flow". Fig. 20 shows a

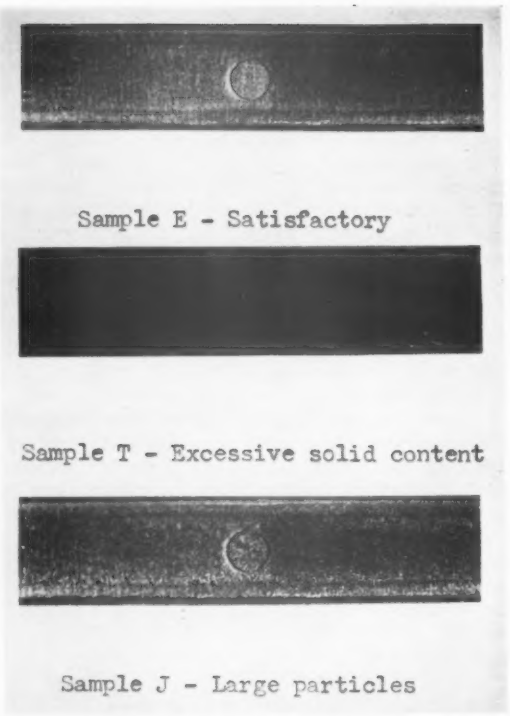

Fig. 21. Standardisation of detecting inks.

universal machine which can provide both these conditions. The operator is checking the flux density of the machine using a Cambridge flux-meter.

When using the magnetic flow method, the part to be examined is placed between the poles of an electro-magnet and the detecting ink applied while the energising current is flowing in the coil. In this method, the lines of force flow from pole to pole through the part, and a defect at right angles to an imaginary line joining the poles is in the most favourable orientation for detection. To attain optimum results, the contact surfaces between the poles and the part under test should be as large and as perfect as possible.

The current flow method entails the use of a low voltage, high amperage current passing through the specimen. In this method, the lines of force are circumferential to the part through which the current flows, and a defect parallel to an imaginary line joining the two contacts is the most favourable orientation for detection. Whenever electric current is passed through a component, precautions must be taken to avoid local overheating or burning. This may be caused by bad or intermittent contact between the component and the contacts of the machine. The risk of burning may be minimised by the use of specially designed clamps and adaptors faced with copper braid or gauze. Contact clamps and adaptors are to be kept clean and capable of being securely locked in position. Overheating may be caused by the use of an excessive current in

relation to the size of the component under examination, or by passing the current for an unduly long time.

The direction of the magnetic field is highly important, and the best results are achieved when the axis of a defect is at right angles to the applied field. For a complete examination of any part it follows that at least two tests, with fields mutually at right angles, are necessary. Examination for longitudinal defects in a hollow part involves the use of a threading bar. Here, a current is passed through a bar, usually of brass, which is inserted through the bore. The circumferential field produced flows into and through the part.

After magnetic flaw detection a part may remain magnetised and may require to be demagnetised before embodiment into aircraft. A part may be demagnetised by passing it through a suitable coil energised by alternating current, and withdrawing the part to a point approximately 5′ distant from the coil. This operation subjects the part to a diminishing alternating field. The most effective demagnetisation is achieved when the coil is so placed that the path of the part, when passing through the coil, is at right angles to the terrestial magnetic field.

In order to achieve consistently good indications of defects, it is necessary to standardise detecting inks. Fig. 21 illustrates the results obtained from different inks, using a standard artificial defect consisting of a piece of mild steel containing a shrunk in dowel plug. The magnetising conditions and quantity of ink used for these tests are to specified values during the tests.

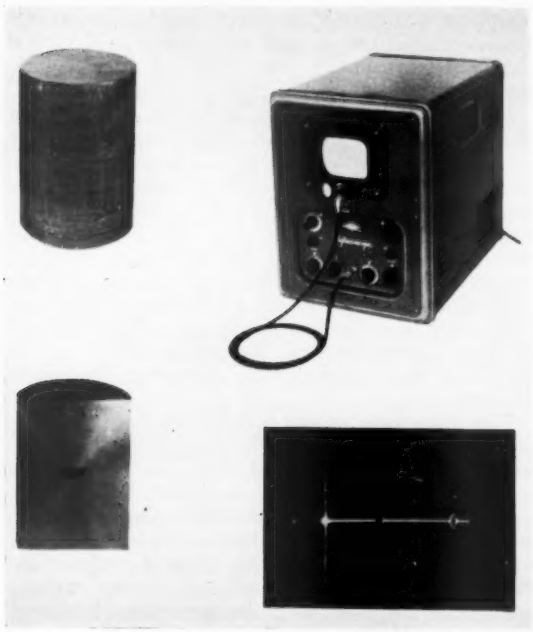

Fig. 22. Ultrasonic flaw detection.

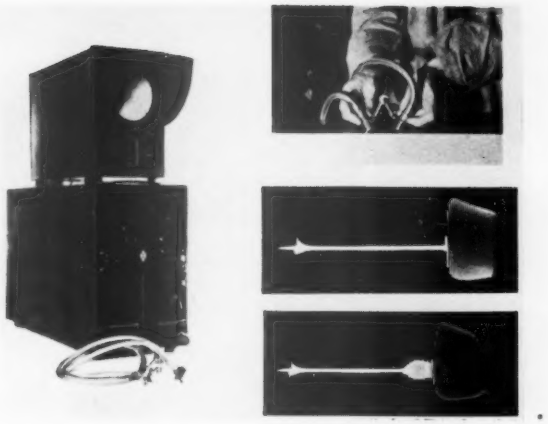

Fig. 23. Ultrasonic flaw detection.

Ultrasonic Flaw Detection

Ultrasonic waves are sound waves of a frequency above the limit of audibility, which is about 20,000 cycles per second. Such waves may be set up in solid specimens and are reflected by cavities, cracks and other defects. This is the basis of ultrasonic flaw detection. The frequencies generally used for this purpose lie within the range 0.5 to 5 megacycles, corresponding to wave-lengths in steel and aluminium of about 0.5 to .05 inches. Such ultrasonic waves may be generated by means of piezo-electric quartz crystals applied to the surface of the specimen. When these crystals are pulsed electrically, they generate mechanical vibration, and when pulsed mechanically, an electrical output. Thus a typical ultrasonic flaw detector consists of a transmitter unit feeding the transmitting quartz, a receiver unit amplifying the electrical output of the receiving quartz, and a cathode ray tube unit.

In some equipments, one crystal serves for both transmission and reception and simplifies the manipulation. Fig. 22 shows an equipment of this type. On applying the single probe to the upper face of the billet an oscillogram of the form shown was obtained. This consists of an initial marker (actually a picture of the transmitter pulse), a good indication from an internal defect and some reflection from the bottom of the casting. The defect can be seen in the sectioned billet.

Fig. 23 shows a two-probe instrument and the method of applying the probes to a typical specimen. The first oscillogram shows a sound specimen giving a boundary echo only, the second oscillogram a defect echo in addition. This was obtained elsewhere on the same specimen.

In addition to the reflection method described in the foregoing, the two-probe type of instrument can be used for transmission tests. Here the transmitter and receiver are on opposite sides of the section under test. Fig. 24 shows a convenient method of testing thin sheet material by transmission, the probes being mounted on a tank filled with water, across which communication is established. The resulting signal is shown in the first oscillogram. When a sound

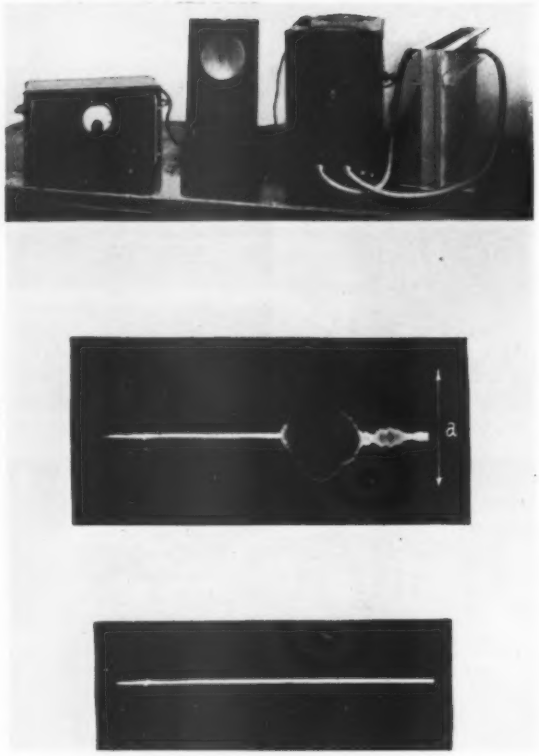

Fig. 24
Ultrasonic flaw detection—transmission method.

specimen is immersed in the tank, a similar indication or slightly reduced amplitude is obtained. A defective specimen, on the other hand, cuts off ultrasonic communication between the probes and causes a loss of the signal as seen in the second oscillogram.

Precision Measurement

"Why is it necessary to measure in millionths of inches?" is still a common question. Today it is commonplace in engineering design to require the part to be measured to a degree of accuracy of one-thousandth part of an inch.

Such parts are associated with the production of aircraft, engines, complicated mechanisms, instruments and other assemblies where the quality of safety, performance, reliability, endurance or interchangeability may be adversely affected if the specified accuracy is not maintained.

In general practice, the workshop and inspection limit gauges used to measure production work are manufactured to one-tenth of the accuracy required on the work. Under the circumstances mentioned these gauges would, therefore, have degrees of accuracies of .0001". In addition to initial inspection, gauges require checking for wear at intervals, depending on usage. Inspection and checking may be carried out by master gauges, cylinders, wires, standard measuring media, etc., having accuracies in the order of .00001" or one-tenth of that of the limit gauges used in the workshop or inspection of the part.

In turn the master gauges, etc., require periodical check against metrological laboratory standards, which have degrees of accuracies of .000001" or one-tenth of the accuracy of the master gauges.

The Metrology Section

The Laboratories in the Metrology Section of the Test House deal with many branches of the subject, from the investigation of the roughness of surfaces to the problems of the determination of lengths up to 100 ft., and from the measurement of angles, to the examination of profiles. The equipment of the Section is very comprehensive and includes many of the most modern measuring machines and apparatus.

One of its primary responsibilities is the determination and maintenance of end, cylindrical, and spherical length standards. Absolute measurement of the length of end standards up to 4" can be made to accuracies of one-millionth of an inch by means of interferometry, whilst those up to 36" in length, and cylindrical and spherical standards are measured by generating methods and optical/mechanical, or electrical/mechanical means, to corresponding degrees of accuracy. The flatness of all end standards is determined by means of optical interference methods to the order of one-hundredth of a thousaudth part of an inch. Angular standards such as angle slips and polygons and parallelism of end standards are calibrated by the use of optical instruments, such as autocollimators which enable readings of 0.2 seconds of arc (one-millionth of an inch per inch of length) to be made.

Slip gauges are calibrated to the order of one-millionth part of an inch on an optical/mechanical comparator, and length gauges to one-hundredth of a thousandth part of an inch on a mechanical/optical measuring instrument with electrical fiducial indicator.

Whilst the determination of lengths of the order of a yard requires the use of a light source of a truly monochromatic radiation, there are a number of light sources which are sufficiently monochromatic to enable lengths up to one inch to be measured, with a degree of accuracy greater than that of the normal methods of measurement. An instrument in which the principles of light interferences are used to obtain linear data is known as an interferometer, and one such instrument has been designed by the National Physical Laboratory for the measurement of slip gauges of the reference and calibration grades of accuracy.

The instrument utilises a cadmium discharge tube as a light source. The light emitted by the lamp passes through a system of lenses and a pin-hole diaphragm into a constant deviation prism which separates the four main radiations of the cadmium spectrum, viz., red, green, blue and violet, each of which may be used in turn by rotation of the prism. The gauges to be measured are wrung radially around the periphery of a circular, rotatable platen, which is itself of a very high order of flatness. A glass reference plate is mounted above the platen, in

Fig. 25
Profile and measuring projectors for gears, hobs and intricate profiles.

a tripod holder, by means of which the reference plate may be inclined at a slight angle to the surface of the platen. The light rays, which are reflected partially at the surface of the reference plate and partially at the surfaces of the slip gauge and platen, are recombined by the observer's eye and interference fringes are seen in the field of view. If the fringes cross both gauge and platen in a straight line, the length of the gauge must be equal to a whole number of half-wavelengths of the particular light being used. On the other hand, if the fringes on the gauge are displaced from those on the platen, the gauge length must contain a fractional part of a half-wavelength, the actual fraction being denoted by the degree of displacement. From these observations in conjunction with special tables and slide rule the size of the slip is determined.

Fig. 25 shows a measuring machine comprising dividing head and projector. It is possible to control the longitudinal movement of the table to the order of .000025" over a traverse of 8". Vertical movement can be controlled by the use of slip gauges and dial indicator. The dividing head can be read to an accuracy of 10 seconds of arc. The projector has magnifications of x 10, 20, 50 and 100.

A more accurate dividing head is used for measuring the angle of spacing of items such as master serration and spline gauges, also master gears to accuracies of 3 seconds of arc, i.e., approximately 15 millionths of an inch displacement at 1" radius. A microscope is used to read a divided circle integral with the spindle. The final setting in seconds of arc being made with a 10" sine bar and micrometer head.

Screw Thread Measurement

Diameter measuring machines are used to take diameters up to 2" with micrometers having a ½" range and reading by vernier to .00001". Other diameter measuring machines are used for diameters up to 12" reading to .0001". For internal threads a radial internal diameter machine with a range of ¼" to 8" reading to .0001" is used. In addition, internal diameter machines are available with ranges from ½" to 5" reading to .00005". For the measurement of thread form a projector of x 20, 50 and 100 is available. Pitch is measured on machines capable of measuring internal and external threads, tapered or parallel, at accuracies of .000025".

The technique illustrated in Fig. 26 was designed and developed by the Test House to overcome difficulties experienced with all direct measurements of wall thicknesses of long tubes, due to the limitations of standard measuring equipment and the inaccessibility of the positions at which the measurements are required. Arms operating in the form of calipers have proved to be most unreliable, except for very short distances. The means of registering the measurements must, therefore, as far as possible, be mechanically independent of any contacting stylus.

The apparatus consists of a beam of channel section carrying an alignment telescope at one end and a measuring anvil at the other. A measuring stylus is held directly over the anvil by a thin walled small diameter support tube, 9 ft. in length, the opposite end of this tube being connected to the beam by a simple form of universal joint. An illuminated target is situated near the plane of the measuring stylus, and displacements of the stylus and target, relative to the measuring anvil, can be viewed through the bore of the stylus support tube by the alignment telescope. The distance between the stylus and measuring anvil is standardised by means of a 0.1" slip gauge, and thus the differences between the slip gauge value and the wall thickness of the tube are measured directly by the optical micrometer of the alignment telescope (nominal tube thickness being 0.1").

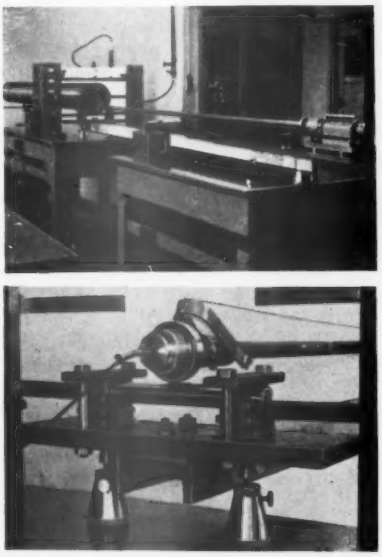

Fig. 26
Measurement of wall thickness from one side of long tubes.

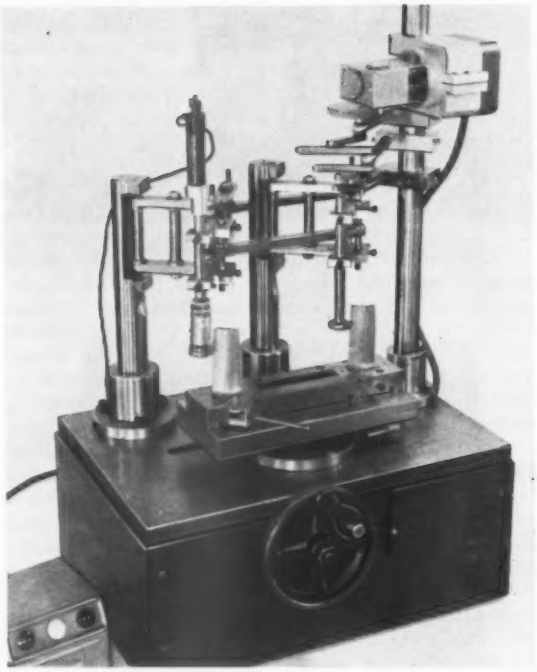

Fig. 27
Measurement of turbine and compressor blade contours.

The measuring stylus consists mainly of a ball race, the outside diameter of which has been ground to form the central zone of a sphere in order to reduce the area of contact. The ball race is mounted on the target housing, which is attached to one end of the small diameter support tube. To prevent wear on the stylus when the tube under inspection is being moved longitudinally to various measuring positions, a jockey pulley is provided to lift the stylus clear of the surface of the tube. This can be operated from the observer's position by means of a cord.

The long tube to be measured rests on mandrels, and can therefore be easily rotated and placed under the measuring head at any circumferential position along its length. The method can be used to measure the thickness of long aircraft spars of hollow sections.

The prototype apparatus illustrated in Fig. 27 has been designed and made in the Test House Metrology Section to cover a particular range of blade contours, and consists mainly of a pantograph carrying a special measuring stylus on one side of the frame and a plain stylus on the other. The plain stylus is made to follow the contour of a master blade and its motion is transmitted through the pantograph to the measuring stylus, which responds to pressures applied at any point on its circumference and which is in continuous contact with the blade under inspection. Thus the differences between the blade section under inspection and the corresponding section of the master blade are registered.

When horizontal pressure is applied to any point on the spherical contacting surface of the measuring stylus, the movement is transmitted to a steel ball which can only move in a vertical direction. A rod contacting the steel ball conveys the movements which can be registered by a dial indicator, automatic graphical recorder, or a light system set to indicate acceptance or rejection of the blade. The mechanism is driven by a small electric motor, and by raising or lowering the platform a blade can be measured at any position to an accuracy of .0003″. A blade of the type shown can be measured around the periphery of three sections in less than half a minute, including the time for location and release of the blade in the machine.

Surface texture metrology deals with the structure, methods of comparison, and classification of surfaces. It is concerned with the operations required to obtain various surface properties, and the influence of finish on wear, lubrication, etc. In this type of work, where the unit of measurement is the micro-inch, mechanical, electrical, and electronic apparatus, having amplification mechanisms of up to 100,000 to 1, is employed. The work includes the design and construction of visual, tactual, and aural means of facilitating the assessment of surface qualities in the workshop itself.

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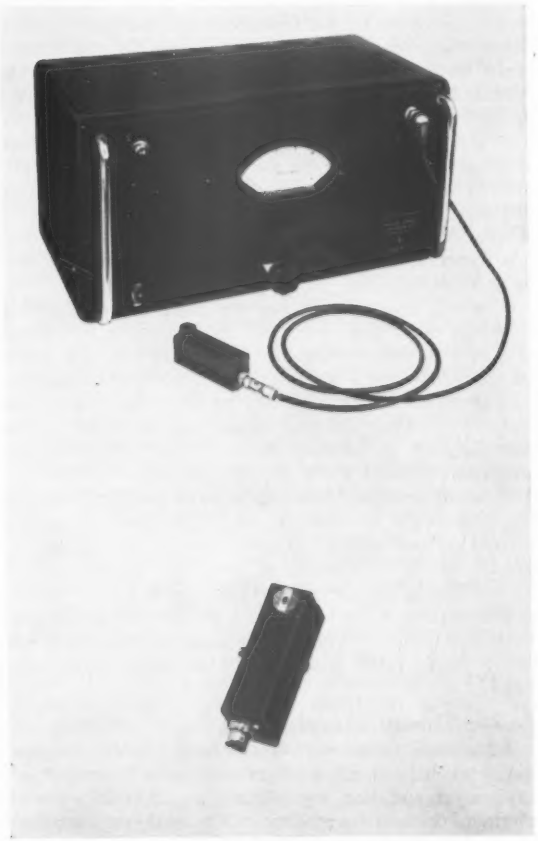

Fig. 28 A.I.D. Surface Texture Meter.

THE MANUFACTURE OF COMPONENTS FROM POWDERED METALS

by W. D. JONES, M.Eng., Ph.D., F.I.M.

(*Presented to the Coventry Section of the Institution on 4th March*, 1953)

The author of this Paper is a Director of Powder Metallurgy, Ltd., London, and of the Schori Metallising Process, Ltd.

He graduated in 1929 at the University of Liverpool, where he undertook post-graduate research into powder metallurgy. He was a lecturer at Sir John Cass Technical Institute, London, from 1931 to 1937 and is the author of the first book in English on powder metallurgy, published in 1937.

Since that date, Dr. Jones has acted in various capacities as a consultant specialising in the field of powder metallurgy.

Dr. W. D. Jones

POWDER Metallurgy can be conveniently defined as the art of manufacturing objects by the moulding and heat treatment of metallic powders. The object made merely by pressing the powder is usually described as the "green compact", the step of heat treating it as "sintering", and the products prepared by the techniques of powder metallurgy will be described here as "sinterings".

Metal powders are manufactured by several techniques. Non-ferrous alloys such as brass or bronze are customarily powdered by atomisation—the molten metal is handled in much the same manner as oil in an oil burner and is atomised by a jet of air, water, or steam. By controlling the jet conditions it is possible to make powders of varying fineness and particle shapes—spherical, tear-drop, angular, or fluffy. (Figs. 1, 2, 3, 4.) Iron and alloy steel powders are also made by atomisation, but the largest tonnage of iron powder employed in powder metallurgy is manufactured by reducing a purified iron oxide ore in a suitable furnace with carbon or a reducing gas, or by a combination of both. Electrolytic and chemical methods are employed for the manufacture of copper and very pure iron powders.

The average metal powder used in powder metallurgy has a consistency of very fine sea sand—in more exact terms, the particles are generally not coarser than 100 B.S.S. mesh and about half is frequently coarser than 300 mesh. In addition to the particle size distribution, it is generally necessary to observe several other properties of a metal powder in order to assess its suitability for powder metallurgy usage —in particular the apparent density, the rate of flow through a specified orifice, the degree to which it compacts under pressure and the strength of the green compact, and of course the chemical composition and purity.

Basic Techniques

The basic techniques of powder metallurgy usually comprise the following operations :—

(i) *Blending.* The various metal powders required, together with pressing lubricants such as stearine, are tumbled in suitably designed mixing containers until homogeneously blended.

(ii) *Pressing.* The mixed powders are pressed in a steel or hard carbide die under pressures of the order of 15 to 60 tons/sq. in., and the green compact so formed must be strong enough to withstand ejection from the die and subsequent handling. Specially designed presses, operated either mechanically or hydraulically, with automatic powder feed and compact ejection, produce normally at the rate of from 10 to 100 pieces per minute, but much higher rates of operation are quite usual.

(iii) *Sintering.* The green compact must then be heat-treated or sintered in order to develop the necessary physical properties. Heating is generally at a temperature substantially below the melting point, although in the case of compacts containing a mixture of two metals, e.g. copper and tin, then the sintering temperature will

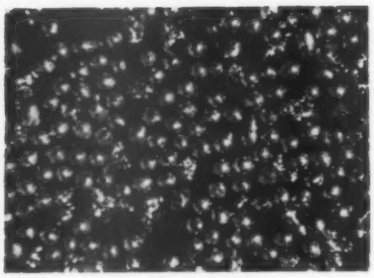

Fig. 1
Atomised spherical powder

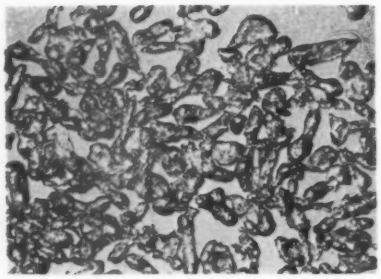

Fig. 2
Atomised tear-drop powder

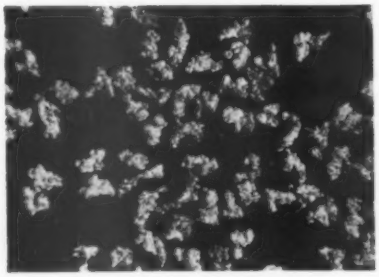

Fig. 3
Reduced fluffy powder

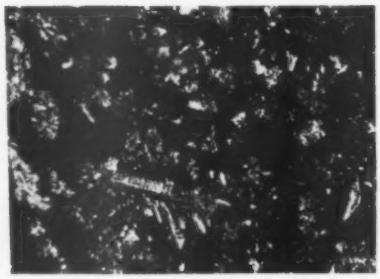

Fig. 4
Electrolytic powder

generally be between the two melting points. The time of heating may vary between several minutes and several hours, but is usually of the order of 30 to 60 minutes. In order to prevent the compact from oxidising during sintering, it is necessary to envelop it in a protective or reducing atmosphere such as combusted town gas or hydrogen or cracked ammonia. Furnaces for sintering have, of course, to be specially designed and are frequently of the conveyor belt or pushed tray type.

(iv) After sintering it may be necessary to press the part again in a die in order to adjust the dimensions. This step is known as sizing or coining.

In many cases, in order to produce parts having exceptionally good physical properties, it is customary to repeat the sintering and sizing operations.

(v) *Finishing treatments.* Final treatments after inspection may include tumbling to remove pressing burrs, electroplating, colouring, or impregnation with oil to produce self-lubricating properties or protect from atmospheric corrosion.

Because of the extraordinarily wide range of physical properties which can be produced in metals and alloys by powder metallurgy, a great variety of articles is made in this way. Some of the most well-known are as follows :—

Highly porous materials.—Oil retaining bronze or iron bearings, chemical or gas filters in porous bronze or nickel or stainless steels, de-icing strips for aircraft.

Unusual electrical or magnetic materials.—Transformer cores, high energy magnets, electron emissive alloys, contacts.

Heat resisting materials.—Tungsten, molybdenum, turbine alloys such as titanium carbide or vitallium.

Very hard substances.—Tungsten carbide machine tools, industrial diamond tools.

Small Part Manufacture

Apart from the above small selection, powder metallurgy is extensively employed in the manufacture of engineering components of iron or steel or brass or bronze. Used in this way, powder metallurgy is a manufacturing technique which competes with other methods of small part manufacture such as machining, die casting, forging, sand-, investment-, or shell-casting.

It is with this branch of powder metallurgy that the remainder of this Paper is concerned, and all further remarks will be confined to the manufacture of small engineering components in brass or iron or steel alloys.

In this field, some of the general advantages of the powder metallurgy technique are :—

(i) In competition with costly machining operations such as milling or broaching or screw machining methods which require more than

one set-up, sinterings can frequently show very considerable economies. This is especially the case where large numbers-off are involved. Broadly speaking, any machine part which can be designed so that its manufacture is reduced to a simple pressing and sintering operation can seldom be made much more economica'ly by any other method. This economic advantage of powder metallurgy is seen in industries encountering very large numbers of small parts of limited ranges of design, particularly in the manufacture of clocks, calculating machines, cash registers, locks, sewing machines, caster wheels, and toys (trains, Meccano and the like).

Low production costs associated with powder metallurgy arise from a number of facts, namely, (a) almost complete elimination of scrap losses, (b) low direct labour charges, (c) considerably reduced stock investment in metal shapes, e.g. one metal powder instead of numerous assortments of extruded or rolled shapes, (d) saving in floor space, expensive machine tools, jigs, fixtures, gauges, cutting tools and transport, (e) reduction in inspection and quality control costs owing to greater uniformity of product.

(ii) A wide range of physical properties is frequently obtainable by employing alloys or aggregates of metals which cannot be manufactured by melting and casting.

Low or high frictional materials or components made deliberately with low density are typical examples.

(iii) Close dimensional tolerances are not difficult to attain and, in general, dimensional accuracy compares favourably with that of other small parts processes. The highest standards of accuracy, however, demand considerable experience of the process and a very close control over rather a large number of variables with an accompanying increase in cost. Generally accepted commercial tolerances for brass sinterings are 0.004″ per inch on radial dimensions, with more liberal allowances for axial dimensions. By sizing after sintering, tolerances of as low as 0.002″ per inch have been met on a production basis.

Certain Disadvantages

There are naturally certain disadvantages associated with powder metallurgy and the principal ones are as follows :—

(i) The raw material—the powder—costs more than ingot metal, in general up to 50% higher, although this is not always so expensive as rolled or extruded sections. This disadvantage is frequently more than offset by the complete absence of scrap losses.

(ii) The shape of sinterings is limited to those items which can be pressed and ejected from a die, and the size is limited to the tonnage capacity and stroke of the press. Few powder metallurgy parts weigh more than 10 lb. and the greatest volume of production lies probably between one and four ounces.

(iii) Each individual part requires a separately designed die and the die cost may in some cases be high, although this may not be at all an important item if the numbers-off are considerable. The high die cost, however, tends to be discouraging in the manufacture of prototypes and a satisfactory solution to the manufacture of a very cheap prototype die would be a great advantage.

(iv) Tool and press maintenance costs tend to be high and it is almost impossible to undertake manufacture by powder metallurgy without a well-equipped tool room. This disadvantage, however, applies equally well to some alternative small part manufacturing techniques.

(v) Metal powders exhibit very little lateral flow in a die and show high frictional effects on the walls of a die. These phenomena prevent the manufacture of parts with re-entrant angles, or with wall thicknesses or variations of less than 0.032″, or with thicknesses very much less than the length. Certain of these points are brought out in more detail in the examples shown in Figs. 5/12, which are intended to assist in explaining the right and the wrong ways to design sinterings. These examples are taken from the catalogue of the International Powder Metallurgy Company of Pennsylvania :

a) Parts with multiple steps can be moulded, but the difference between steps or offsets must be a minimum of .032″. Wall sections of less than .032″ increase tool maintenance costs. (Fig. 5).

b) Chamfers or bevels of less than 30 deg. cannot be moulded; 45 deg. chamgers are preferred. For less than 30 deg. the moulding punch would come to a feather edge. Such an edge will not stand up under the high moulding pressures required (30,000—100,000 p.s.i.) increasing die maintenance costs. (Fig. 6).

c) Ball shaped parts, or spheres can be moulded, but a flat spot is required to prevent the moulding punches from coming together. This flat spot will be within the spherical

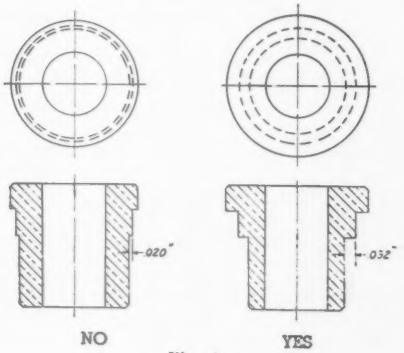

Fig. 5.

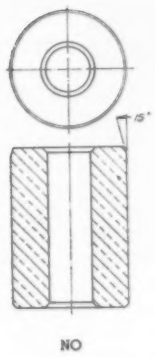

Fig. 6.

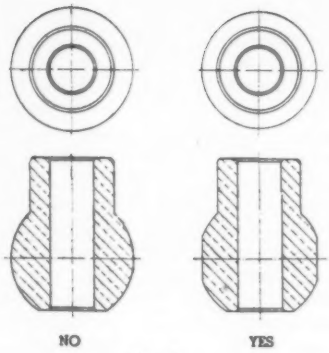

Fig. 7.

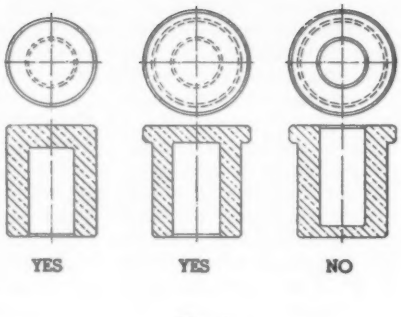

Fig. 8.

section and will not interfere with a ball seat. (Fig. 7).

d) Blind end parts can be moulded. However, if a flange or any offset is opposite the blind end, one or the other must be eliminated to provide for ejection from the die. (Fig. 8).

e) Avoid parts with abrupt and large changes in cross sectional areas. They are difficult to mould or maintain uniform densities. (Fig. 9).

f) Reentrant angles cannot be incorporated in the die. They must be machined in subsequent operations. (Fig. 10).

g) Avoid parts with a minimum wall thickness of less than .032". Dies are costly and sometimes impossible to construct and maintenance is high. (Fig. 11).

h) Holes at right angles and external grooves cannot be moulded. They can easily be machined in subsequent operations. (Fig. 12).

Present Day Applications

In order to describe more accurately the position that powder metallurgy holds at the present day as a small part manufacturing technique, the remainder of this Paper will deal with specific examples. These have been drawn, as far as brass is concerned, from a publication entitled "Facts about Pressed Brass", published by The New Jersey Zinc Company of New York.

Sheet metal stamping processes usually show low costs, but in the example shown in Figs. 13 and 14, the powder metallurgy technique competes with an estimated cost saving of 33⅓, mainly by avoidance of scrap loss. The two parts illustrated are brass sinterings used in a Mullins dish-washer timer and made by Merriman Bros. of Boston.

The hexagonal centre pivot hole and the six round satellite holes of the double acting cam are produced in the pressing operation by core rods. The two parts illustrate the ease with which radial contours and raised projections can be produced by powder metallurgy. Tolerances specified for these parts were as follows :—

Trip hole in cam	0.125 + 0.001 in. — 0.000 in.
Pivot hole in lever	0.140 + 0.001 in. — 0.000 in.
Spring terminal hole in lever	0.125 ± 0.002 in.
Cross section of lever	0.187 ± 0.003 in.
Where not specified	± 0.005 in.

Coining after sintering was employed to maintain these tolerances.

Manufacture of lock parts by sintering from leaded

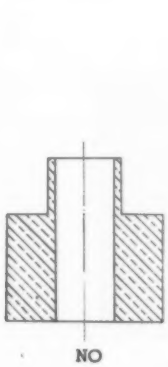

Fig. 9.

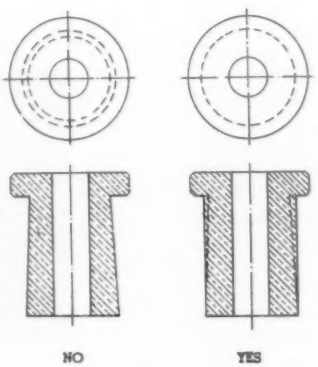

Fig. 10.

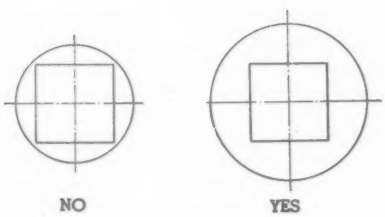

Fig. 11.

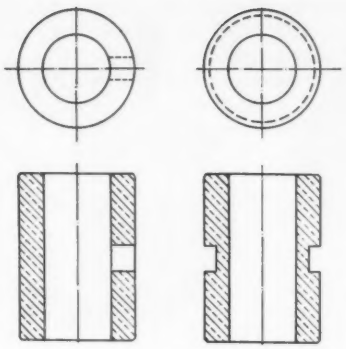

Fig. 12.

brass powder is in America associated with several important advantages including :—

i) Low unit costs.
ii) Close tolerances.
iii) Fewer total operations.
iv) Lower direct labour costs.
v) Lower scrap loss.
vi) Equal or superior physical properties.

Compared with sand casting, manufacture of Yale locks by sintering showed a 35% saving in man hours and a better lock cylinder was produced with a saving of 12 finishing operations.

A sand cast surface is rough and machining is essential where smooth surfaces or close tolerances are required The 25-step sequence given below was formerly necessary to produce a finished Yale lock cylinder by sand casting. Fabrication by sintering eliminated the 12 finishing operations marked* :

1. Make cores.
2. Mould.
*3. Chop off.
*4. Grind face and back.
*5. Rough-ream plug hole and rough-cut to length.
*6. First-ream plug hole.
*7. Rough bevel.
*8. Rough face.
*9. Counterbore plug seat.
*10. Mill for spot and bar cut.
11. Drill pin holes.
12. Ream plug hole.
13. Drill, countersink and tap two ear holes.
14. Ream pin holes.
15. Ream plug hole.
16. Disc pin holes.
17. Stake pin holes.
*18. Finish-ream plug hole.
*19. Clean counterbore for plug seat.
20. Broach for mushroom drivers.
21. Finish cut to length.
*22. Finish face, turn outside diameter and bevel.
23. Finish ream and counterbore.
24. Polish.
*25. Stamp "Yale".

The illustrations on page 276 show the cylinder at various stages of manufacture :

Fig. 15. Cylinder as sintered.
Fig. 16. After (1) straddle-milling clearance for connecting screws.
Fig. 17. After (2) tapping two screw holes, (3) drilling pin holes, and (4) reaming pin holes.
Fig. 18. After (5) reaming plug hole, (6) discing pin holes, (7) staking pin holes, (8) finish cutting to length, and (9) broaching for mushroom drivers.
Fig. 19. After (10) reaming and cleaning counterbore and plug hole, and (11) polishing.
Fig. 20. Finished lock assembly. Note cleanliness of detail.

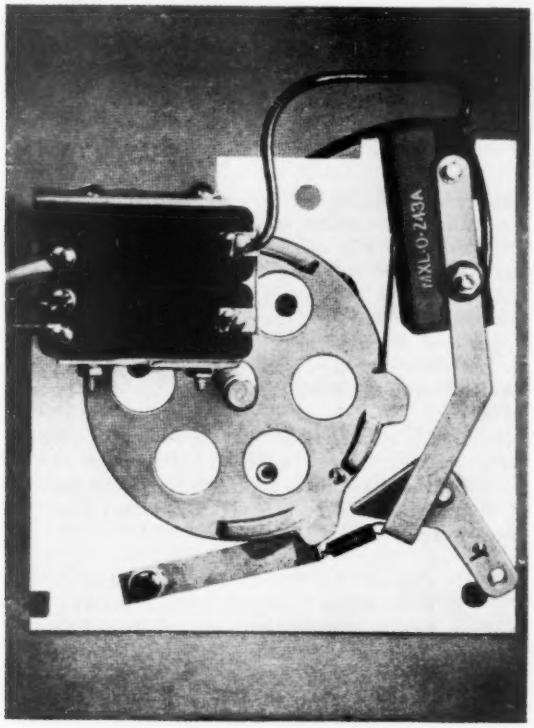

Fig. 13.

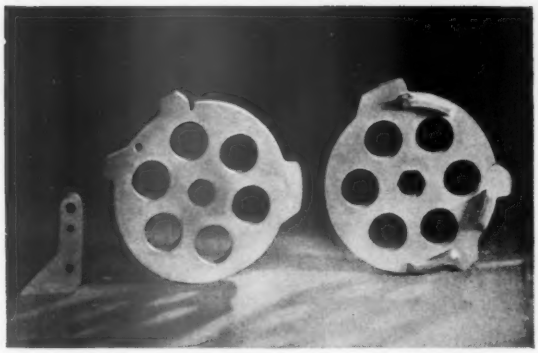

Fig. 14.

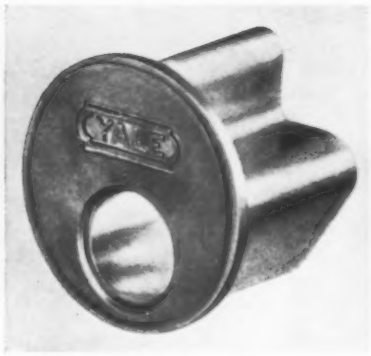

Fig. 15 Cylinder as sintered.

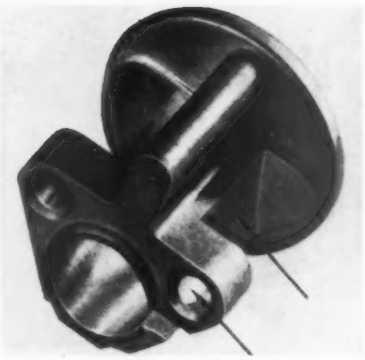

Fig. 16. After (1), straddle-milling clearance for connecting screws.

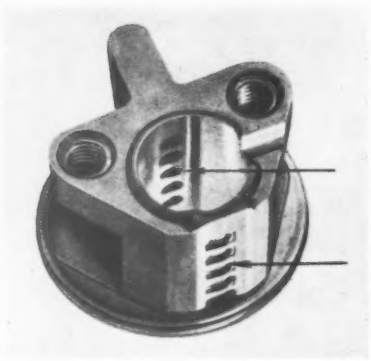

Fig. 17. After (2), tapping two screw holes, (3) drilling pin-holes and (4) reaming pin holes.

Fig. 18. After (5) reaming plug hole, (6) discing pin holes, (7) staking pin holes, (8) finish cutting to length and (9) broaching for mushroom drivers.

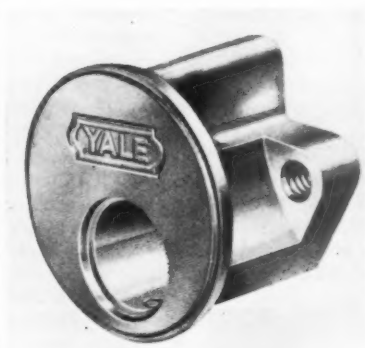

Fig. 19. After (10) reaming and cleaning counterbore and plug hole and (11) polishing.

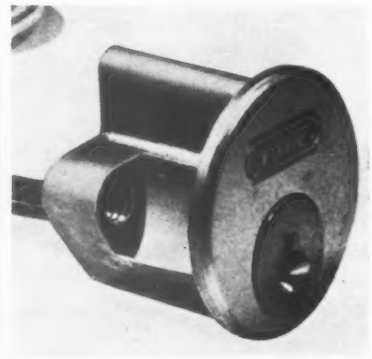

Fig. 20. Finished lock assembly. Note cleanliness of detail.

Cost studies made by engineers of the Contract Division, Lewyt Corporation, show that structural parts need not be elaborate to realise the economies inherent in forming shapes from metal powders. For some shapes, raw material cost savings alone may justify conversion; in other design situations, reductions in machining costs may assume especial importance.

The three, 48-pitch hub-gears (A) illustrated in Fig. 21, formerly were fabricated at a satisfactorily rapid production rate on a gear-cutting machine, using bar stock. However, the scrap loss was high, as metal removed in machining is waste.

For the quantities involved (above 20,000 of each piece) the powder metallurgy tool and die costs were not excessively high—and finished parts could be produced as 90-10 brass sinterings at a net 25% saving, because there is no scrap loss.

Dimensional accuracy of the gears after coining is the same as that of machined gears $\frac{+0.000 \text{ in.}}{-0.002 \text{ in.}}$ tolerance on the gear pitch, and 0.002 in. total indicator reading for concentricity. Mechanical properties for gears of this pitch are lower when made as sinterings, but entirely satisfactory for the application on variable condensers.

Collars B and C are elementary shapes—whether made by screw machine or by powder metallurgy. However, screw machine time per 100 pieces is one half hour for the two operations of cutting rod to length and drilling hole. As 90-10 brass sinterings, the parts are produced well in excess of 1,000 pieces per hour—and the direct labour costs are considerably lower.

Adjustable stop D is another Lewyt part (quantity requirements: approximately 50,000) for which powder metallurgy is the most advantageous method. By the former method, machining costs per 100 pieces were :

1. Cut off	½ hour
2. End-milling	2 hours
3. Counterboring	½ hour
4. Drill holes (3 at a time) ...	½ hour
Total	3½ hours

A foot of .75-in. diam. brass rod yielded 16 pieces.

Even though the powder metallurgy tooling costs for this design are approximately 200 per cent. higher, elimination of the 3½ hours machining time brings the piece price of sinterings (90-10 brass) down to less than half of that of machined parts, tool costs included in both instances. Note that the three 3/32-in. blind holes in the base of the part, which formerly required one half hour (per 100 pieces) machine time, are now formed in the pressing operation. Allowable tolerances for the part are ±0.003 in. on most dimensions.

Classification of Sinterings

It is convenient to classify iron or steel sinterings into three types, highly porous, porous, and dense, representing porosities of more than 20%, between 10% and 20%, and less than 10%. The highly porous article is used purely because of its porosity, e.g. for oil impregnated bearings, shell driving bands, sealing rings impregnated with asphalt, etc. In the second, porous, category can be included more than 70% of all machine components made by powder metallurgy and these generally replace machined bar stock or machined cast iron or malleable castings. In the third, dense group, are included components having much higher strength requirements than can be obtained from cast iron, with in many cases physical properties as good as any heat treated alloy steel.

The highly porous, and porous, ferrous sinterings are manufactured generally from an oxide reduced iron powder by one pressing and sintering followed, if necessary, by sizing. The dense components are made either by a double pressing and sintering technique or by a copper alloy infiltration method. Frequently a more expensive electrolytic iron powder accompanies the oxide reduced powder, to improve the physical properties and various alloying elements may also be added. Sintering is usually undertaken at 1100 to 1150°C for 45 to 60 minutes, although in the case of resintering the temperature and times may be increased.

Fig. 22 shows a typical selection of porous parts manufactured by one pressing and sintering. For this class of production, ultimate tensile strengths of 8 to 14 tons/sq. in. can be expected, dependent upon the density with elongations between 1 and 5%. Carburising can easily be undertaken and hardnesses up to Rockwell C 65 obtained. Dimensionally, porous iron parts can be held to moderate tolerances and without coining ±0.005 in. can be maintained without too much trouble and ±0.002 in. with coining. Such low density sinterings are frequently, nowadays, replacing many machined parts which are becoming difficult to make because of material shortages or costs. Provided the parts are not overstressed, they will perform equally well with parts made from wrought material and in many cases the porosity, by impregnation with oil, can be turned to a distinct advantage. However, the chief justification for the use of this type of sintering is that of economy and the cost saving that can be brought about, largely by avoiding scrap production, is often most surprising.

Considering now dense ferrous parts made by

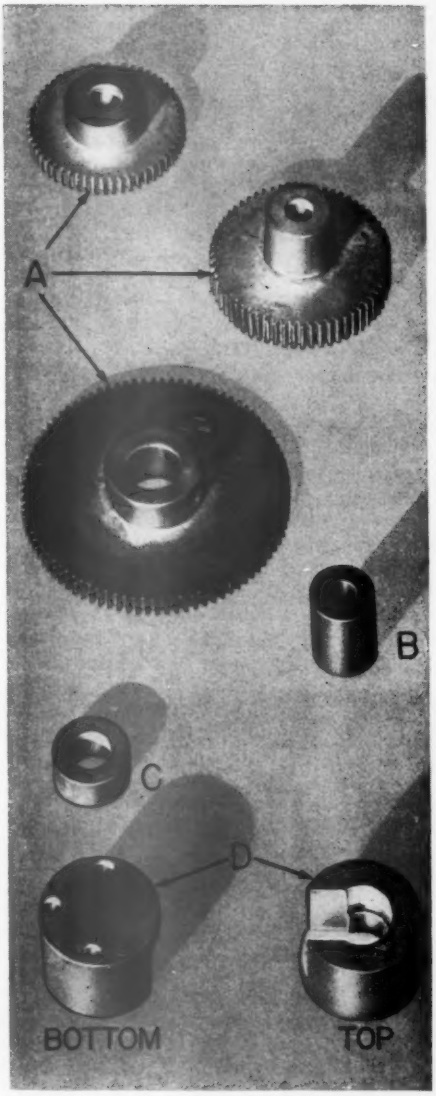

Fig. 21.

powder metallurgy, a good illustration of the manufacture and application of this type of technique is provided by the operations of the National Cash Register Company of Ohio, which were described in the May, 1952, issue of *Precision Metal Moulding*. Very similar techniques are being employed in Britain, Sweden, and Italy, among other countries of Europe, for the manufacture of Ordnance components and, in particular, sewing machine, cycle, and calculating machine components.

Fig. 23 shows a selection of components used by the National Cash Register Company. It is understood that the Company uses at least 35 different sinterings in its manufactures and plans to employ more. In every case, the part has a density of at least 99% of

theoretical and no part is employed that does not have physical properties at least as good, if not better, than the component it replaced. The justification in each case has been a substantial reduction in cost. In spite of the fact that an expensive electrolytic iron powder is employed, the cost of manufacture has been kept low, mainly by the use of tungsten carbide dies and high carbon high chrome punches and carbide tipped core rods. No die has ever shown any appreciable wear and one pair used for both pressing and coining has made over three million pieces.

The pressing and sintering cycle employed is as follows :—

1st and 2nd Pressing : 60-65 tons/sq. in.

1st and 2nd Sintering : 45-60 minutes at 1130°C in Endogas.

The final density is almost achieved after the first sintering, and the coining and second sintering is used partly for dimensional control and partly for grain refinement and improvement of ductility.

In the case of the manufacture of the counter pinion, powder metallurgy has replaced the operations of blanking, shaving and machining, and has reduced the number of operations from 20 to 12 and the number of inspections from 7 to 5. The piece is carburised to a depth of 0.015 in. and then hardened and tempered to a final hardness of 40 Rockwell C. The one long tooth is rehardened inductively to 62 Rockwell C. The impact properties of the teeth are considerably improved compared with the component previously manufactured from punching stock. Normal tolerances are held to ± 0.001 in. and only occasional spot checks are made, instead of routine inspection of 25 to 100% of the pieces when made by machining.

A New Technique

Infiltration with a copper alloy is a new technique which is being increasingly employed for the economical manufacture of high density high tensile components by powder metallurgy. In this case the pressing step is undertaken with comparatively low pressures, thus permitting long life of cheaper die sets and the relatively porous part after sintering has the pores filled up with a molten copper alloy—for example, an alloy of copper with 5% of manganese and 5% of iron. The added alloy does more than just fill up the porosity, for a certain amount of alloying with the iron occurs and surprising improvements in physical properties can be achieved, ranging from a 20 ton tensile with 20-30% elongation to 45 ton tensile with 1 to 4% elongation. The infiltration technique thus permits the production comparatively

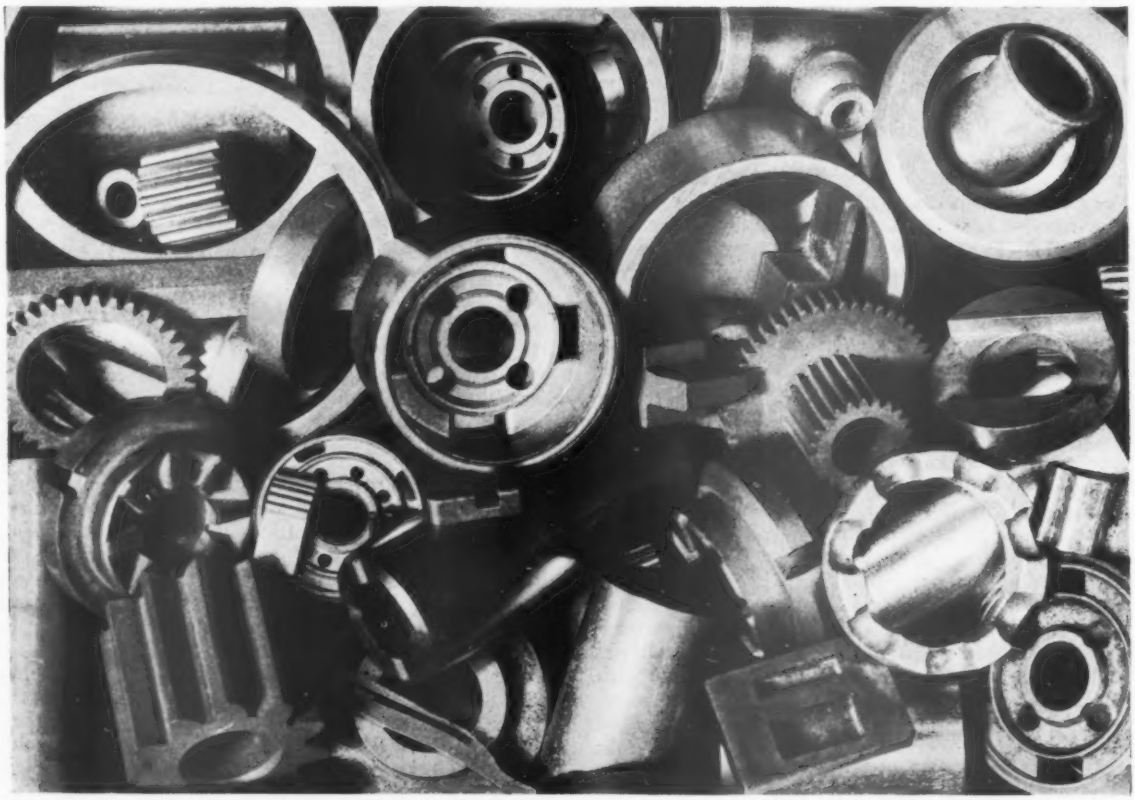

Fig. 22. Typical selection of porous parts manufactured by one pressing and sintering.

cheaply of a wide range of good physical properties.

One interesting application was described by Daniel W. Hoyt in "Iron Age" of 23rd August, 1951. This concerns the impellor blade in a Westinghouse 'Waste-Away' machine for shredding all types of kitchen refuse and causing it to disappear down the kitchen sink. The impellor blade, shown in Fig. 24, was formerly made from a high carbon high chrome alloy steel casting which required six costly machining operations.

Starting with electrolytic iron powder pressed to about 80% density, the compacts were sintered in an Endogas atmosphere at 1100°C and then infiltrated. This step was undertaken by placing over the sintering a green compact pressed from a copper alloy powder. By repassage through the furnace this copper alloy compact melts and sinks into the iron compact. After infiltration the parts

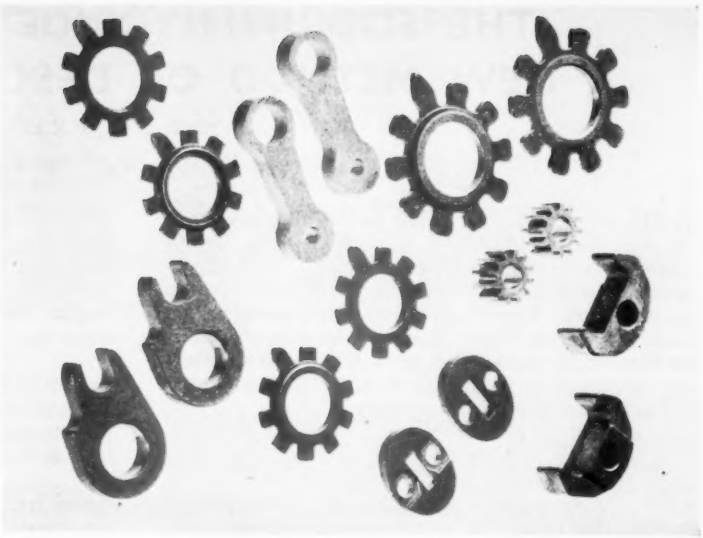

Fig. 23
Selection of components used by the National Cash Register Company.

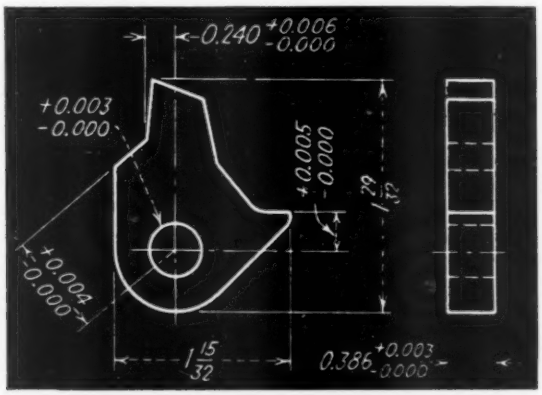

Fig. 24
Impellor blade for a Westinghouse "Waste-Away" machine.

are pot carburised and then reheated and quenched in cyanide.

Unit tests on the impellor consist of shredding 600 - 700 lbs. weight of raw bones at 1,800 r.p.m. Wear tests on the first production lots made consisted in using them in a works cafeteria, where some 1,200 meals a day were disposed of for three months continuously. After this experience the units were still found to be in excellent condition and the powder metal part henceforth has replaced the cast alloy metal formerly used—a successful if undignified application of the latest advances in powder metallurgy, although better by far than shell driving bands and machine gun components.

Whether we approve or not of the direction in which man is going, there can be little doubt that powder metallurgy is getting him there a little more quickly.

BRITISH STANDARDS

The following Standards have recently been issued and may be obtained, post free, at the prices stated from the British Standards Institution, 24-28, Victoria Street, Westminster, London, S.W.1 :—

1918 : 1953 Glass Container Finishes. (2/6)
1936 : 1952 Undercuts and Run-outs for Screw Threads. (3/-)
1937 : 1953 Engineers' Ratchet Braces and Drilling Pillars. (4/-)
1943 : 1953 Woodworking Chisels and Gouges. (4/-)
1946 : 1953 Flat Dies for Thread Rolling. (4/-)
1916 : Part I : 1953. Limits and Fits for Engineering Part I—Limits and Tolerances (10/-).
1958 : 1953. Tools for Soldered Socket-Spigot Joints for Lead and Lead Alloy Pipes (2/6d.).
1963 : 1953. Pressure-Operated Relay Valves for Use with Town Gas (2/6d.).
1965 : 1953. Seamless Steel Butt-Welding Pipe Fittings (3/-).
1966 : 1953. Domed Ends for Tanks and Pressure Vessels (2/6d.).

THE SODIUM HYDRIDE PROCESS— A NEW METHOD OF DESCALING METALS

by N. L. EVANS, B.Sc., F.R.I.C., F.I.M.

Synopsis of a Paper presented to the West Wales Section of the Institution.

THE use of acids for pickling metals to descale them has the disadvantage of attacking the parent metal, as well as removing the scale. With cheap materials such as mild steel, the metal loss incurred is not serious, but in the case of expensive alloys such as stainless steel, nickel-chrome alloys, etc., it becomes much more important; and when the pickling operation is prolonged, there is the additional risk of surface pitting taking place.

A method of eliminating such losses is provided by the sodium hydride descaling process, which also opens up the possibility of overcoming some of the other disadvantages of acid pickling. This process operates by means of a powerful reducing agent which is entirely without action on the metal being descaled, but which reduces the oxide scale to the condition of powder metal.

The bath used for this purpose is molten anhydrous caustic soda at a temperature of 350° to 370°C, in which is maintained a concentration of about 2 per cent. of sodium hydride, which is the active reducing agent.

The material to be descaled is immersed in the bath for only a short time (usually 30 to 60 seconds) after it has reached the bath temperature. Preheating is an aid to attaining the minimum immersion time. Very thick scale such as is produced on steel drop forgings may call for a longer immersion, up to 10 minutes after reaching bath temperature.

The effect of this treatment is to reduce oxide scale and leave it in a loosely adherent condition. The next operation is to quench the work in cold water. The steam thus generated blasts most of the reduced scale off the surface. The small amount remaining may, in certain cases, be useful in subsequent operations such as wire drawing, where it helps in lubrication and sometimes results in a startling increase in the die life.

Scale on mild steel is normally left in a flaky condition and does not always come away completely from the parent metal on quenching. It can be removed by means of a high pressure water jet applied after quenching. Similar means are also adopted for the final cleaning of stainless steel sheets after hydride descaling and flash pickling.

The plant for carrying out this process is constructed almost entirely of mild steel, which is virtually unattacked. Baths for containing molten caustic soda should be fabricated by electric arc welding, of a high standard of workmanship. When all fabricating processes liable to set up stresses have been completed, the entire vessel should be stress-relieved by heating it in a muffle to a temperature of 650°C, followed by slow cooling in still air.

The bath is preferably heated by means of external electric resistance elements, but gas heating is a possible alternative. As a certain amount of sludge is formed in the bath in the course of the descaling operation, it is important to avoid heating from the bottom of the tank and even on the sides, direct flame impingement should not occur.

Safety of Operators

In designing the plant, due attention should be paid to the safety of the operators, by screening the hydride bath and quench tank, and by the provision of goggles and other safety equipment. Baths designed for the continuous descaling of strip or wire are usually almost completely enclosed, and do not therefore need screening.

The floor surrounding the hydride bath should be of open steelwork, 3″ or so above a drained concrete floor. Any caustic soda which is spilled may then be hosed away.

Provision is also needed for the removal of sludge from the bath. The usual method is to operate the bath with sludge trays in the bottom, these being removed about once a month for emptying. There should be two sets of trays available, so that when one set is removed from the bath it may be replaced by a clean dry one.

Sodium hydride is generated in the plant by direct reaction between sodium metal and hydrogen, the latter being obtained from cracked ammonia. A mild steel generator box is suspended in the bath, or, in the case of a large installation, there may be several generators.

Application

The sodium hydride process may be applied to a wide range of metals, including cast iron, steels of all types, including stainless, high speed and other alloy steels, in the form of sheet, strip, wire, bar, castings, forgings and parts fabricated by welding, also nickel and its alloys and other non-ferrous metals with the exception of tin, zinc and other metals subject to attack by caustic soda. In addition to descaling, it can be used for the removal of last traces of sand from castings.

Its advantages are, the absence of attack on the metal so that overpicking is impossible; its speed, permitting its use in a continuous production line, instead of the batch treatment usually needed for acid pickling, the absence of destructive action on the fabric of buildings in which it is carried out; and the low capital cost, on account of the plant being almost wholly fabricated from mild steel. Also, it does not induce hydrogen embrittlement or weld decay in metals under treatment, and the same bath may be used, whatever metal is being cleaned.

THE ELECTRON MICROSCOPE

by M. Venner, B.Sc.(Eng.), A.M.I.E.E., M.Amer.I.E.E.

(Synopsis of a Paper presented to the Manchester Section of the Institution, 19th November, 1951.)

INTRODUCING this Paper, the author defines the resolution of the human eye as the shortest distance between two small points of light when they can just be seen as separate sources. By the use of a magnifying glass, greater distinction is possible, and by multiplying the lens system, the device known as an optical microscope is evolved.

Resolution and Wavelength

It is pointed out that this instrument limits useful magnification to about 1,200 times, useful magnification being that which just enlarges the resolution of the instrument to the resolution limit of the eye.

It is stated that since 1860, when Abbé proved that the maximum resolution of any lens system was proportional to the wavelength of the light used for illuminating the specimens, only restricted progress has been made in the design of the optical microscope, in that better means of examining objects larger than the resolution limit have been provided, and use has been made of shorter ultra-violet waves to improve the resolution limit.

Optical Design of Electron Lenses

After referring to the building, in 1932, of a microscope using electrons with a resolution equal to that of the optical instrument, the author outlines development difficulties and describes a modern electron microscope.

Power Supplies

In this section of the Paper, the generation of operational power and the stabilisation of lens current is dealt with in some detail.

Operation and Applications

Here the author analyses and discusses the operational results obtained from the electron microscope, giving a description of methods of examining specimens. Electron microscopes are at present used in the U.K. in connection with a variety of materials, including industrial powders, metallurgical specimens and surfaces of all types, biological specimens and fibres in industry.

The Paper concludes with a forecast of future development and some useful comment on mechanical design considerations and manufacture.

Note: *The complete Papers, described in these synopses, are available on loan from the Hazleton Memorial Library to members of the Institution.*

(Concluded from page 270)

Importance of Surface Finish

Industry has now realised that the type of surface produced by machining processes is of great importance, as a particular surface finish is necessary to the satisfactory performance of many machine elements. In the manufacture of internal combustion engines, for example, the desired surface finish is now specified for many of the parts. In some cases, the maintenance of these standards of finish is essential to obtain satisfactory operating conditions.

Instruments just mentioned are expensive and mainly for use in the laboratory. An instrument at reasonable cost for general workshop use is, therefore, essential. Such an instrument has been developed by the Electrical and Metrology Sections of the Test House and is shown in Fig. 28.

After considerable experiment a method employing a Crystal Transducer and electronic amplifier was decided upon. The surface to be measured is hand traversed by a tracer head consisting of a suitably mounted "hill-and-dale" crystal transducer unit. The stylus vibrates with an amplitude depending on the surface texture, and for a given amplitude the output e.m.f. of the crystal is substantially independent of frequency and therefore of the speed of traverse. The output e.m.f. from the crystal unit is amplified in an amplifier with a flat response between 33 c/s and 20 kc/s. The amplifier output is indicated by means of a rectifier type instrument scaled in micro-inches C.L.A. (Centre-Line Average). Below 33 c/s, the amplifier has a sharp cut-off of about 30 dB per octave, the purpose of which is to attenuate long-wave components on the sample being measured. This also has the advantage of greatly reducing spurious "kicks" on the indicating meter due to hand shake, etc.

The transducer unit contains a piezo-electric crystal in the form of a thin slab to which are affixed electrodes on opposite faces. One end of the slab is clamped to the case of the transducer unit and the stylus is mounted on the other end. Vertical movement of the stylus in relation to the body of the unit causes the crystal to bend and this produces an e.m.f. at the pair of electrodes, the amplitude of which is proportional to the displacement of the stylus. The e.m.f. thus generated is communicated to the co-axial plug by means of the flexible connection shown.

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THE BRITISH PRODUCTIVITY COUNCIL

AT an informal meeting of Council held at 36, Portman Square, London, W.1, on Wednesday, 22nd April, 1953, members were addressed by Sir Ewart Smith and Sir Thomas Hutton, of the British Productivity Council.

The Chairman (Mr. Harold Burke), in introducing the speakers, said that the Institution was keenly interested in the work of the British Productivity Council and was eager to take some action and to participate, as far as it could, in the organisation of the various Productivity committees throughout the country.

Function of the British Productivity Council

Sir Ewart Smith, stating that the Council had been set up to act as a focal point and centre of stimulus in the United Kingdom on the matter of productivity, said there was no need to tell members of the Institution of Production Engineers of the necessity, economically, for higher productivity. They probably had the clearest ideas, individually and collectively, about what could be done and the need for doing it.

He viewed the position in which the country found itself and was likely to find itself tomorrow and next year, as a personal as well as a collective challenge, and likened the national economy to an Eskimo adrift on an ice-floe; having been fishing, he had not realised that the floe had broken away from the pack-ice; now a south wind was driving him towards the broad Atlantic, and unless he did something quickly the floe would break and drop him into a very deep and inhospitable sea.

This country could do anything to which it set its hand, but it must know where it wanted to go and must have the leadership and the collective spirit and enterprise to do it. That was, broadly, the background of the Council.

Necessity for Joint Action

The Council by itself could not do very much. It had a huge job covering the whole country. Therefore, every man and organisation of understanding and goodwill must come into it as a joint enterprise. It was not a question of "kudos", labels, prizes or plums; it was a job of real hard work in which everybody must play his part.

The Council had decided first of all clearly to state in simple language what it was trying to do, and why. For this purpose it had issued a pamphlet, "The Objective", which was a very general statement containing the Council's declaration of faith.

The Council had the task of educating not merely the workers but the nation—politicians, civil servants, even the top management of industry and the distributive services, as to what was necessary and also what was possible.

It had been decided that the field could be broken down logically in two ways, the "verticals" and the "horizontals"—the men and the means. As to the "verticals", three groups had been planned. First, there were the trade associations of all kinds, including the trade unions. Secondly, there were all the professional and educational bodies. Thirdly, there would be a regional association of bodies either existing or to be formed.

The "horizontals" were the written word, the spoken word and visual aids. In order not to set up too many committees, the Council had begun by grouping together the written word and the spoken word, the work being divided between five main committees.

The trade associations already existed on the employers' side and on the trade union side, and the British Productivity Council committee for liaison with those associations would include trade union and employers' leaders.

Use of Existing Bodies

It was desired as far as possible to use existing bodies of all kinds on the regional organisations. It was felt that in the main centres of industry there should be set up what were in effect minature "productivity councils", to draw together locally all the interested people in the same way as the British Productivity Council was doing nationally.

The national Institutions, such as the Institution of Production Engineers, would, Sir Ewart was sure, go out of their way to take part and ensure that their effective and active members became members of the guiding committees of the local productivity units. Some of the existing regional organisations would be used to begin with, but he hoped that the local Productivity committees would eventually become self-contained and self-supporting. While information, films and literature would be distributed from London, it was hoped that they would have the initiative and the energy to drive ahead in their own region in whatever way might be appropriate.

Dealing with the written and the spoken word must be a continuing process. On the question of continuity, those concerned with the work visualised it as something very different from—although it was a continuation of it—the work of the Anglo-American Productivity Council. That Council had one main job which it did extraordinarily well and it had been extremely valuable. An analysis had been prepared of the 58 American Productivity Team Reports, grouping their findings and the points on which they put emphasis. The main thing coming from any analysis was that it all depended on attitude of mind.

People with the right approach and knowledge

must be found to concentrate on the written and the spoken word, and they would pass their knowledge on to the other bodies and the local productivity centres.

Co-operation with Other Bodies

The Professional and Educational Committee, which would shortly meet for the first time, intended to co-opt people from other bodies which were very active in that field and had knowledge, information and methods of approach which would be of use to the Council. It was desired to keep the Committee small and active, and it would be willing at any time to meet and collaborate with anyone working in the same field.

The British Productivity Council was urgently in need of the assistance, constructive criticism and active co-operation of Institutions, like the Institution of Production Engineers, in the vitally important task of putting the country where they all knew it could be. But it would not be done by talk; there had to be work and education. It was no good blaming the privates or the workmen if the battle or the order was lost; in the long term, the workmen and the privates were what the captains in industry and the Generals in the Army had made them. The best way to get education down to the shop floor was to make sure that what was wanted from the people at the top was known, and that the true economic facts of the country were made known all the way down through the managerial chain to the men on the shop floor. It was management that mattered; as managers, Sir Ewart concluded, they had a most serious responsibility.

Composition of the Council

Sir Thomas Hutton explained that the Council was representative of the Federation of British Industries, the British Employers' Confederation, the T.U.C., the National Union of Manufacturers, the Association of British Chambers of Commerce and the nationalised industries.

It was embarking first of all upon the local Productivity Committees. It had asked the chairmen and vice-chairmen of the District Committees of the Regional Boards to take the initiative in forming these local committees. The object was to get a local organisation representative of management, technologists and trade unions which would start a series of lectures, discussions and other activities which would help to spread the knowledge of the latest and most modern techniques in industry. Already 105 areas had been approached to form councils. The Council had gained so much from co-operation at the higher level that it felt it should be instituted at the lower level. The discussions and so on were intended not for the highest grades of management or technologists, but for the middle or lower ranks—foremen, chargehands, trade unionists, trade union officials and possibly shop stewards, and so on.

The last thing the British Productivity Council wished to do was to compete with or to overlap the operations of other bodies in the same field, nor did it wish to lay down an exact pattern as to what should take place. Every help would be given to the local Productivity Committees, but it was essential that they should get good chairmen and secretaries and work out good programmes. It was hoped that local branches of bodies such as the Institution would co-operate fully, not only in providing personnel for the local Productivity Committees, but also providing persons prepared to talk about industrial techniques and give the benefit of their knowledge to the lower ranks in industry.

The circuit scheme for works visits was based on the lessons learnt by the Productivity Teams in the United States. There was just as much to be gained by the exchange of knowledge between British firms as by the exchange of knowledge between British and American firms, although it might not be exactly the same knowledge. It was hoped that a large number of firms would take part in the scheme by sending comparatively small teams drawn from all levels to visit other firms in the same area. There might be difficulties about visiting competing firms in the same industry, but there was tremendous value in teams visiting firms in other industries.

Film Programmes

The Council was entering on a film programme. Two types of film were in mind. One was for films of general education about productivity which would be under the general heading of "There is Always a Better Way". The idea was to show the better methods introduced into industry and agriculture which showed remarkable results and enabled people to do things more quickly and easily. The films would probably be seen on television and in commercial cinemas, and they would also be available to people who wanted to show them. The needs of localities would indicate film requirements, and such films would then be prepared by the most competent people for the task.

Much literature was in existence, but there would be gaps, and the Council would probably have to approach bodies such as the Institution to fill them. There would probably be a considerable need for information on modern techniques in pamphlet form, expressed in simple terms, to be distributed to the people who attended the meetings and discussions.

As regards other literature, the Council was publishing the Reports of 66 Teams, which would help on the work. Some of particular interest to the Institution, such as that on planned maintenance and inspection, had recently been published, and in the next few months Reports would be coming forward on design in production, production control and industrial engineering. So far as there was anything of real value in them, he hoped that the Institution would do all it could to disseminate them and get them discussed in the branches.

Use of Case Studies

There would also be a need for the publication of case studies. The Council had recently published reviews of industries which had sent teams to the United States, but in the case of specialist teams which had studied techniques common to a wide area

of industry, that might not be the right approach. The Council might ask for the help of the Institution in producing case studies dealing with the application of some of the techniques in practice. The Institution had helped in the production of a publication on case studies in Materials Handling, which was selling well.

The Council would ask the Institution to provide a member of the Films Committee, who would be able to help by his knowledge of industry, his imagination and his technical knowledge on the way the Council should approach the making of films.

The work of the Council might indicate subjects which required a certain amount of investigation. The Council was not an appropriate body to indulge in research, but it might suggest to the professional Institutions subjects which called for investigation.

Next month, the Council would publish a book by Graham Hutton, called "We, Too, Can Prosper". Mr. Hutton was a well-known economist and his book was based on the experience of the Productivity Teams and his own knowledge of British and American economic and industrial conditions. It was hoped that it would do much to educate the population at large and industry as to what could be done and what ought to be done.

Importance of Work Study

Taking Work Study in its broadest sense, the Council felt that a great deal more required to be done. It would discuss that with various organisations. It was prepared to put its resources into it or to stand aside, if advisable, and let someone else get on with it.

The Council's budget was about £20,000 a year. Half was provided by the subscriptions of the constituent organisations, all of which, including the T.U.C., had made generous donations towards the work. The Council was able to do more than it might otherwise have been able to do as a result of additional aid. The U.S. Government had put a considerable sum of dollars at the disposal of the British Government, on condition that the sterling counterpart of the fund should be employed on measures calculated to increase the productivity of British industry in its widest sense. The money was being allotted by the Board of Trade. The Council hoped to receive a considerable share to support the activities in which it proposed to engage.

Sir Thomas Hutton spoke of some of the practical problems of administration which would be involved.

Following a discussion during which the speakers dealt fully with points raised by members, Mr. Walter Puckey, a Vice-President of the Institution, proposed a vote of thanks to Sir Ewart and Sir Thomas.

After what members had heard, said Mr. Puckey, the British Productivity Council could be assured of the Institution's fullest possible support and co-operation in achieving its objectives.

REPORT OF THE MEETING OF COUNCIL

Thursday, 23rd April, 1953.

THE last Council Meeting of the present Session took place at 36, Portman Square, London, W.1, on Thursday, 23rd April, 1953. Mr. Harold Burke, Chairman of Council, presided over the Meeting, which was attended by 37 Members. Also present were Mr. R. W. Wall, Chairman of the Western Graduate Section, and Mr. G. P. Gummer, Chairman of the Sheffield Graduate Section.

Council dealt with the routine business of the Institution.

Election of Principal Officers, 1953/54

It was proposed by the President, seconded by the Chairman and unanimously agreed that Mr. Walter Puckey, M.I.Prod.E., F.I.I.A., Deputy Controller of Supplies (Aircraft Production), Ministry of Supply, be elected President of the Institution for the year 1953/54.

The President said that Mr. Puckey's position in the engineering world and the public affairs of the country was so distinguished, particularly at the present time, that the Institution was doing itself a real service by electing a man of his activity, energy and achievement.

The Chairman said that he heartily concurred in the President's remarks. He felt sure that all would join with him in expressing regret that Sir Cecil Weir was unable to continue in office, but he could think of no one in the Institution better fitted to take office as President than Mr. Puckey. It was particularly gratifying in view of the fact that there was recent evidence before the Council of the sterling work performed by Mr. Puckey as Chairman of Council.

It was proposed by Mr. A. L. Stuchbery, and carried with acclamation, that Mr. Harold Burke be re-elected Chairman of Council, and Mr. G. R. Pryor, Vice-Chairman of Council, for the year 1953/54.

New Headquarters

The President asked Council to give their sanction

to the purchase of new premises at 10, Chesterfield Street, London, W.1. In his view, this building would make very satisfactory headquarters for the Institution, which was growing in importance all the time. He proposed that in order to avoid any drain on the ordinary funds and revenue of the Institution, an invitation committee be formed to sponsor an appeal for funds, this committee to consist of Past Presidents and Past Chairmen of Council, together with the present Council.

Council examined the financial statement regarding the new premises and gave their approval to the purchase of the building and the launching of an appeal fund.

British Productivity Council

The Chairman referred to the meeting held on the previous evening, when Council had had the good fortune to be addressed by Sir Ewart Smith and Sir Thomas Hutton on the newly-formed British Productivity Council. (A Report of this Meeting appears on pages 282/284.)

Articles of Association

Following the discussion at the last Council Meeting, the proposed changes to the Articles were again debated at length. The comments of Section Committees were considered in detail and voted upon. On the motion of the Chairman, the final form of the changes as discussed and amended was approved. The proposed changes will be submitted to the corporate membership at a General Meeting.

A vote of thanks was passed to Mr. G. R. Pryor, Vice-Chairman of Council, and to Mr. W. F. S. Woodford, Institution Secretary, for their work in preparing the Articles for discussion.

Finance

Expenditure for the nine months of the year to date compared favourably with the total budget, and it was probable that the budget surplus would be attained.

Annual Dinner, 1953

Council noted with pleasure that Sir Rupert de la Bère, Lord Mayor of London, had accepted the Institution's invitation to attend the Annual Dinner at the Guildhall on 9th October.

Education

Council approved the Education Committee's recommendation that the Institution's Higher National Certificate Prize for 1952 be awarded to Mr. W. E. Simpson, a student of the Chance Technical College, Smethwick.

Membership

The Chairman of the Membership Committee reported that they had embarked on a programme of visits to Section Committees in order to discuss membership policy and to ensure the maintenance of understanding and co-operation between the Section Committees and Council.

Institution Paper

The Papers Committee reported that the Viscount Nuffield Paper, 1953, would be presented in London by Lord Sempill, A.F.C., towards the end of the year.

Research

The two new Sub-Committees of the Joint Committee on the Measurement of Productivity, who are dealing with "Production Control" and "Works Statistics", have held their first meetings and have commenced their investigations.

Standardisation

The Standards Committee reported that a list of British Standards have been prepared and circulated to Technical Colleges for the use of students studying for the Institution's examinations.

Hazleton Memorial Library

Following a circular letter to affiliated firms, it was reported by the Chairman of the Library Committee that many additional requests for books and information had been received. Work was proceeding on the compilation of a catalogue.

Oxford Sub-Section

Council approved a recommendation by the Reading Section Committee that the Oxford Sub-Section be granted full Section status.

Applications for Membership and Transfer

Council approved a number of applications for membership and transfer. Particulars appear on pages 286/287.

Local Section Reports

Council adopted the Local Section Reports, extracts from which appear on pages 287/290.

Staff Resignations

The Secretary reported, with regret, that three resignations had been received from the permanent staff. Mr. T. B. Worth, Education Officer, Mr. G. E. Knight, Assistant Secretary (Education and Membership), and Mr. N. R. Tribble, Accountant, were all leaving to take up other appointments.

Mr. Woodford said he was very sorry indeed to lose these members of the staff. They had constituted part of a splendid team, but this was one of the problems the Institution had to face, by reason of its policy of employing young progressive men. He desired to record his own appreciation of the work of Mr. Worth, Mr. Knight, and Mr. Tribble, and to say how sorry he was personally to lose their co-operation in the office.

The Chairman of the Education Committee, Mr. J. France, said he felt that the occasion should not pass without an expression of great regret at losing the services of Mr. Worth and Mr. Knight, but they left with the very best wishes of all concerned.

Mr. Worth was leaving the service of the Institution but not, fortunately the service of production

engineering. In his new sphere he could give the Institution perhaps still greater help. Mr. Knight was branching out into something entirely new which offered him excellent prospects, and Mr. France knew he was voicing the feeling of the Education Committee in saying that they had every confidence that Mr. Knight would justify it.

Mr. A. L. Stuchbery said it was important that Council should realise what a great contribution Mr. Worth had made in the educational sphere and he felt sure that it would be of satisfaction to Mr. Worth to know that the Institution thought so highly of what he had done.

With regard to Mr. Knight and Mr. Tribble, those who had worked with them had the highest opinion of them, and their leaving was undoubtedly causing anxiety at the moment. It was pleasing to think that young men could come into the Institution and by serving it so we'll be presented with great opportunities. This would undoubtedly assist in securing the services of other bright young men. He wished them all well in the future.

Mr. B. G. L. Jackman said he desired to pay a tribute to the work which Mr. Tribble had done. From his experience on the F. & G. P. Committee, he could say that Mr. Tribble had done an excellent job and although that Committee had formally thanked and congratulated him, it was desirable that it should go on record that Council were of the same opinion. Mr. Jackman also wished to endorse the remarks already made concerning Mr. Knight and Mr. Worth.

It was unanimously agreed that Council should formally record the Institution's appreciation of the work which had been done by Mr. Worth, Mr. Knight and Mr. Tribble.

Obituary

The deaths of the following members were recorded with regret:

Member

W. Haywood.

Associate Members

W. E. Darby, T. Feather, C. E. Thompson.

Student

F. V. Kingdon.

Associate

H. Bradburn.

Date of Next Meeting

Thursday, 23rd July, 1953, at 11 a.m., at 36, Portman Square, London, W.1.

ELECTION OF MEMBERS

23rd April, 1953

The following were elected to membership by Council:—

BIRMINGHAM SECTION

AS ASSOCIATE MEMBERS

F. J. Barnett, J. E. Earl, L. W. Homan-Berry, R. McCracken, J. W. Morris, J. O'Neill.

AS GRADUATES

G. T. G. Bayliss, G. F. Brigginshaw, S. H. Ellens, C. P. Jones, A. E. Fell, Z. N. Mirza, R. Neale, W. E. Simpson.

AS STUDENTS

J. L. Aston, A. K. Deshmukh, E. Hind, A. C. Mosely, W. A. Woodfield.

TRANSFERS

FROM ASSOCIATE MEMBER TO MEMBER

R. P. Eccles.

FROM GRADUATE TO ASSOCIATE MEMBER

A. Dancer, E. A. Wright.

BOMBAY SECTION

AS ASSOCIATE MEMBER — O .P. Danda.

AS STUDENT — C. Mahesh.

CALCUTTA SECTION

AS MEMBER — B. Basu

AS ASSOCIATE MEMBER — M. Das

AS ASSOCIATE — S. K. Roy.

AS GRADUATE — G. Mustafa.

TRANSFERS

FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER

N. Krishnamurti, T. B. Brook.

FROM STUDENT TO GRADUATE

M. Abd-Ul-Wahhab.

COVENTRY SECTION

AS ASSOCIATE MEMBER — V. A. V. Saich

AS GRADUATES — R. T. Hall, J. G. H. Pearce.

AS STUDENTS

B. W. Ball, W. G. Harris, B. D. Lancaster, R. C. Simmonds.

TRANSFERS

FROM ASSOCIATE MEMBER TO MEMBER

W. P. Gill.

FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER

W. A. Orland.

FROM GRADUATE TO ASSOCIATE MEMBER.

A. R. Manning, J. Shephard, M. G. Ward.

DUNDEE SECTION

AS ASSOCIATE MEMBER

S. S. O. Cohen.

TRANSFER

FROM GRADUATE TO ASSOCIATE MEMBER

A. Lowson.

EASTERN COUNTIES SECTION

TRANSFER

FROM STUDENT TO GRADUATE

R. W. Sawyer.

EDINBURGH SECTION

AS ASSOCIATE MEMBERS — F. Moseley, A. S. Wilson

AS STUDENT — J. Dawson.

GLASGOW SECTION

AS ASSOCIATE MEMBERS — A. Kelly, J. Pollock, T. R. W. Pyper.

AS STUDENT — A. M. Greig.

TRANSFER

FROM ASSOCIATE MEMBER TO MEMBER

D. S. Gardner, F. H. Perkins.

HALIFAX SECTION

AS STUDENT

A. S. Wood.

TRANSFERS

FROM GRADUATE TO ASSOCIATE MEMBER

W. H. Crawshaw.

LEICESTER SECTION

AS MEMBERS

A. Griffiths, H. L. Haslegrave.

AS ASSOCIATE MEMBERS

R. C. Atkins, C. Burfoot, S. Hurstwaite, W. Ladds, W. Peck, B. A. J. Rule, E. J. Smith, E. D. H. Sugden, W. K. Temple, G. A. P. Wadlington.

AS GRADUATES — D. Asdell, M. S. Malik, N. Mansoor, G. R. Seymour.

AS STUDENTS — J. W. Banks, J. M. Caunt, S. I. Sheikh, W. V. Wheeler.

TRANSFERS

FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER

A. S. Nicholls, R. J. A. Reid.

LINCOLN SECTION

AS ASSOCIATE MEMBERS

W. Cooper, F. A. Cross, G. Hutchinson, R. P. Knibbs.

AS STUDENT

P. Jeffery.

TRANSFERS

FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER

T. B. Roe, L. Wright.

LIVERPOOL SECTION

AS STUDENTS

E. Brown, C. E. Copeland, W. K. Cubbin, G. D. Kendrick.

AFFILIATED FIRM

British Insulated Callenders Cables Limited

CHANGE OF AFFILIATE REPRESENTATIVES

D. Gluxon, H. Macdonald Steward.

TRANSFER

FROM GRADUATE TO ASSOCIATE MEMBER

F. W. Walton.

LONDON SECTION

AS MEMBERS — J. R. Bunney, E. M. Foulkes, W. G. T. Hedge.

AS ASSOCIATE MEMBERS — D. J. G. Bowen, H. T. Harman, W. Long, R. Parmenter, A. G. Redwood, J. C. Stockwell, E. E. Webster.

AS ASSOCIATE — C. P. Fox.

AS GRADUATES — J. S. Allen, A. D. Davies, J. T. Delury, P. F. Harrison, J. Owens, D. G. Parsons, K. A. Willy.

AS STUDENTS

D. W. Abbott, K. W. Chappell, J. E. Crimp, B. C. Haas, B. A. Haynes, D. H. Hills, L. R. Kent, W. S. Kohn, W. P. Lawler, D. L. Mitchell, B. H. Noyes, G. M. Vine, P. D. Stocker, L. T. D. Taylor, S. W. Wray.

AFFILIATED FIRM — Ingersoll-Rand Co., Ltd.

CHANGE OF AFFILIATED REPRESENTATIVE — J. E. Halbing.

TRANSFERS

FROM ASSOCIATE MEMBER TO MEMBER

R. A. J. Inns.

FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
P. S. G. Cadman, H. E. Manwaring, G. T. Meager E. J. Peek, F. J. Prior, J. E. Skea.
FROM GRADUATE TO ASSOCIATE MEMBER
L. C. Fensom, K. D. Heagarty, R. E. Hyde, W. Keeling, A. J. Thame.

LUTON SECTION

AS ASSOCIATE MEMBER
M. Northwood

AS GRADUATES	AS STUDENTS
R. H. Cannon, D. Gillings, S. Soundranaya-Gam, A. J. Trussell.	H. W. Dilley, G. F. Evans, P. V. Frost. D. B. Rolls, A. D. P. Wright, J. A. Wright.

TRANSFERS
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
W. H. Jaye, A. C. Price, R. L. Roberts.
FROM GRADUATE TO ASSOCIATE MEMBER
C. S. Brewer, H. G. Payne, F. Swain, H. J. C. Weighell.

MANCHESTER SECTION

AS MEMBER	AS ASSOCIATE MEMBERS
C. R. English.	C. Holmes, F. Landmann, K. W. Macartney.
AS GRADUATES	AS STUDENT
P. W. Blake, N. Murphy, F. C. Summers, J. H. Whittall.	F. K. Bryce.

AFFILIATED FIRM	CHANGE OF AFILLIATE REPRESENTATIVES
Platt Bros. & Co., Ltd.	A. Jones, T. Calverley.

TRANSFERS
FROM ASSOCIATE MEMBER TO MEMBER
H. S. Smith
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
F. J. Taylor.

MELBOURNE SECTION

AS GRADUATE
C. H. Butt.

NEW AFFILIATED FIRMS	AFFILIATE REPRESENTATIVES
Electrolux Pty., Ltd.	G. E. Jodell, E. J. O. Rydeberg.
Sutton Tool & Gauge Mfg. Co., Pty., Ltd.	H. H. Hoch, J. Dlavell.

TRANSFERS
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
C. Howard.
FROM GRADUATE TO ASSOCIATE MEMBER
K. W. H. Baldock.

NORTH EASTERN SECTION

AS ASSOCIATE MEMBERS
T. A. Horsley, R. Jaroslav, L. R. Truman, G. W. Wynn.

AS GRADUATE	RE-INSTATEMENT AS GRADUATE
R. W. Pickard.	J. Jackson.

AS STUDENT
W. D. Beadle.

TRANSFERS
FROM ASSOCIATE MEMBER TO MEMBER
J. W. Taylor.
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
F. C. Evans, S. Hall, L. H. Tibbels.
FROM GRADUATE TO ASSOCIATE MEMBER
G. Howard, G. D. Robinson.
FROM STUDENT TO GRADUATE
J. Talbot.

NORTHERN IRELAND SECTION

AS MEMBER
W. C. Beauchamp.

NOTTINGHAM SECTION

AS MEMBER	AS STUDENT
E. Gardner	A. Newton.

PRESTON SECTION

AS GRADAUTES	AS STUDENT
A. Hunt, B. F. Oddie.	R. Hutton.

READING SECTION

AS ASSOCIATE MEMBER	AS GRADUATE
T. E. H. Rickard.	G. N. Iley.

AS STUDENTS
H. D. Chapman, M. C. Lovejoy.
TRANSFER
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
H. J. Harries.

ROCHESTER SUB-SECTION

AS STUDENT
R. J. Crouch.

SHEFFIELD SECTION

AS MEMBER	AS ASSOCIATE MEMBERS
O. F. Lewis.	H. Stafford. M. F. Stuart-King.
AS GRADUATE	AS STUDENT
A. D. Moring.	R. F. Scholey.

TRANSFER
FROM GRADUATE TO ASSOCIATE MEMBER
G. P. Gummer.

SHREWSBURY SUB-SECTION

TRANSFER
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
J. L. Congrave.

SOUTH AFRICA SECTION

TRANSFERS
FROM ASSOCIATE TO ASSOCIATE MEMBER
A. W. Black.
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
C. J. Fisher.
FROM GRADUATE TO ASSOCIATE MEMBER
A. D. Lane.

SOUTHERN SECTION

AS STUDENT
C. G. J. Gould.
TRANSFERS
FROM ASSOCIATE MEMBER TO MEMBER
T. K. Watridge.
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
W. McNeill.

SOUTH ESSEX SUB-SECTION

AS STUDENT
A. R. Devereux.

TRANSFER
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
A. E. Thomas.

SYDNEY SECTION

AS MEMBER	AS GRADUATES
G. P. Taylor	J. Rector, D. F. E. Swinfield.

SOUTH WALES SECTION

AS ASSOCIATE MEMBER
W. E. Thomas.

AS GRADUATE	AS STUDENT
P. K. Wainwright	G. E. R. Mobley.

STOKE-ON-TRENT SUB-SECTION

AS ASSOCIATE MEMBER	AS GRADUATE
H. Burrows.	E. J. Averill.

WESTERN SECTION

AS ASSOCIATE MEMBER	RE-INSTATEMENT A ASSOCIATE MEMBER
C. W. Hotchen.	J. H. Allen.

AS STUDENT
B. E. Trott.
TRANSFERS
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
L. E. Foote, W. B. Nivison.
FROM STUDENT TO GRADUATE
M. E. Reynolds.

WEST WALES SECTION

AS ASSOCIATE MEMBER	AS GRADUATE
R. W. May.	R. D. Riley.

AS STUDENT
C. G. Parry.

WOLVERHAMPTON SECTION

AS GRADUATE	AS STUDENTS
G. Washbrook.	T. J. Harrison, C. J. Mickelwright.

TRANSFERS
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
J. Hill, A. E. Morris

YORKSHIRE SECTION

AS ASSOCIATE MEMBER	AS GRADUATES
B. R. Higgins.	F. Cawood, F. S. Gawthrope.

AS STUDENTS
M. L. Myers, N. Swaminathan.
TRANSFERS
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
F. J. Dixon.
FROM GRADUATE TO ASSOCIATE MEMBER
J. P. Welburn.

NO SECTION

AS ASSOCIATE MEMBER	RE-INSTATEMENT AS ASSOCIATE MEMBER
V. Solaja, G. Taylor.	W. G. Rooke.
AS GRADUATE	AS STUDENTS
C. J. J. de Breet, K. M. Butt.	R. A. Ackermann.

TRANSFERS
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER
L. Rutherford, F. Westhead.

EXTRACTS FROM LOCAL SECTION REPORTS

Presented to Council, 23rd April, 1953.

Birmingham Graduate

A draft questionnaire concerned with interest in Institution activities organised by this Section has been circulated to members.

In the last three months, the circulation list of posters and visitors' cards has been increased, and it is hoped that additional publicity may be obtained by advertising functions in Works Magazines. Every effort is being made to keep the press informed about the Section's activities.

The monthly Graduate Club Night appears to have become a permanent function. It is intended that these take the form of a Supper Club and a Film Evening on two dates in the near future.

Bombay

The Annual General Meeting was held on 25th March, when Mr. E. H. Y. Burden was elected President, and Mr. J. V. Patel Vice-President for the ensuing year. At the conclusion of the meeting the retiring President, Mr. R. A. P. Misra, gave a very interesting paper on "Planning A Heat Treatment Shop".

On 31st March, the Bombay Section held the first of what will become their Annual Dinners, at the Taj Mahal Hotel. The Guest of Honour was Dr. Jivraj N. Mehta, Minister for Finance, Industries and Prohibition.

Calcutta

On 8th January, the Section were fortunate in having Prof. T. U. Matthew, of the University of Birmingham, to give a talk, together with a film on "Productivity Studies". The Annual General Meeting will take place next month. Works Visits have been made to the National Carbon Co. and the Hindustan Motors' Plant.

Considerable correspondence and discussions have taken place with Mr. D. L. Deshpande of the Institute of Technology at Sindri, and it is hoped that the Calcutta Section will be of assistance to Mr. Deshpande. The Management Courses at the Institute at Kharagpur were well received, and were visited by a number of members.

Canada

On 21st January, a well-attended lecture was given by representatives of The Canadian Carborundum Company of Canada, Ltd., on "Bonded Abrasives". On 5th March, Mr. E. J. Schneider, of English Equipment Company of Chicago, delivered an excellent talk dealing with the general application of optical tooling in the engineering industry. Among those present were representatives of the two major aircraft companies in Ontario. Mr. Schneider referred to the high standard of the discussion being the best in which he had participated.

Following a meeting between the Section Chairman and the representative of the Association of Professional Engineers of the Province of Ontario, friendly relations have been established between the two bodies, which can now work side by side for the common purpose of maintaining a high standard for the profession.

It is with regret that the Committee have accepted the resignation, as a Committee member, of Mr. Selwyn Pritchard, due to pressure of business.

Cornwall

A map of Cornwall, with pointers and numbers indicating the distribution of members throughout the Section, is now displayed at full Section meetings.

In January, Mr. B. E. Stokes, Associate Member, of Joseph Lucas, Ltd., presented his paper, "Planning and Controlling the Processes of Production—Machine Aspect". The second meeting of the year took the form of a local discussion on incentives.

Coventry

The Committee had the pleasure of welcoming Prof. T. U. Matthew to the March Committee Meeting, it having been resolved to obtain expert information and advice with regard to Extra-mural Studies. Prof. Matthew outlined the objects of these studies, and the procedure necessary for inaugurating lecture courses and a number of examples of subjects likely to prove of particular interest to Production Engineers were discussed at some length.

Coventry Graduate

The February programme was centred round the Douglas D. Davis Award, and three Graduate members presented papers on "Profit Sharing", "Materials Handling and Factory Layout", and "Time Study".

In conjunction with the Institute of Industrial Administration, a Management Forum was held at the end of February.

The Graduate Section is co-operating with the senior Section in discussing suitable subjects for Extra-mural courses.

Eastern Counties

At the January meeting one of the local members, Mr. R. Craven, gave a lecture on "Motion Study". Mr. J. Lewis lectured in February on "High Frequency Induction". The lecture session ended in March with a Machine Tool Symposium, contributed by five local lecturers. Interesting examples of machine tool developments in local industries were fully explained and illustrated.

At the Annual General Meeting, Mr. E. N. Farrar was elected Section President, Mr. F. T. Dyer, Vice-President, and Mr. A. B. Brook, Section Hon. Secretary.

Edinburgh

The last lecture meeting of the 1952/53 Session has now been held. The success of the Section can be fairly judged by attendance and membership, and certainly in the Edinburgh area membership is increasing.

Justifiably it can be said that the Section has been successful and the lectures well received, especially those with local appeal, namely, "Corrugated Case Manufacture" and "A Talk on the History and Construction of the Domestic Gas Meter". The same procedure will be pursued for the coming Session of having three outside and three local speakers; a film night and a ladies' night are also proposed.

Glasgow

During the quarter, three Papers have been presented: "An Engineering Analysis of Organisation"; "American Valve Industry"; and "Increased Productivity by the Use of Compressed Air". In March, Mr. M. C. Timbury led a very interesting discussion on "Possibilities of Radial Drilling". The Annual General Meeting followed this discussion, and Mr. W. P. Kirkwood was re-elected President, and Mr. M. C. Timbury, Vice-President. Messrs. R. R. Ayton, F. H. Perkins, D. W. Russell and G. V. Stabler were elected to the Section Committee.

Gloucester & District

During the quarter the first two lecture meetings of the newly-formed Sub-Section were held. The first, "Work Study", by Mr. J. R. Ibbs, of I.C.I. Ltd., was held in Gloucester, and in January, Mr. R. C. Fenton of Alfred Herbert, Ltd., presented in Cheltenham his paper on "Some Interesting Set-ups of Modern Machine Tools". The Committee considered that both meetings were very successful and augur well for the future of the Sub-Section.

The Annual General Meeting was held in April.

Halifax

Attendance at two of the three meetings held this quarter has been good; the February blizzard was responsible for reduced numbers at the lecture held on the 10th, but those who did brave the elements were amply rewarded by the excellence of Mr. R. K. Allan's lecture on "The Manufacture of Ball and Roller Bearings".

The March meetings was the occasion of a joint gathering with the Institute of British Foundrymen, and all present were highly delighted with the lecture on "The Engineering Potentialities of Spheroidal Graphite Cast Iron, with special reference to the Machine Tool and General Engineering Industries", presented by Dr. A. B. Everest.

A new departure will be a Film Evening for the closing meeting of the Session.

Leicester

The most successful meeting of the present Session, so far, was held on 8th January, when members and guests heard an excellent Paper by Mr. G. Butler, entitled "Planing Machines and Practice". On 23rd January, a joint meeting was held at Loughborough College with the Loughborough Scientific Society. This meeting was of an exploratory nature and the attendance of approximately fifty indicates that an extension of activities in this area is fully justified.

Liverpool Graduate

Attendances at all meetings this Session have been very good. It is hoped that this standard will be kept for the very last meeting of the Session, in April, which will be in the form of a Film Evening. This improvement in attendance, it is felt, is due to the fact that the Committee have tried as far as possible to arrange meetings to coincide with the Technical College holidays.

London Graduate

During the forthcoming Session, consideration is being given to meeting members in outlying areas, with the possibility of holding one or two lectures away from Central London. With the attendance at works visits declining, it has been decided to arrange fewer visits and to concentrate on those where one or two aspects of production can be studied, and where an official will be available to lead a discussion and answer questions. It is hoped that the 1953/54 programme will be supported by a week-end School, which has become a popular feature of the Section.

An Interim Report is now available which has been issued by the Technique of Tooling Study Group. Thanks must be given to the initial leadership of the Section Vice-Chairman, Mr. J. C. Z. Martin, and to the Group Secretary, Mr. Wittenberg, and to all members of the group for the work which has been invaluable in producing this Interim Report.

Luton

A joint meeting of the Senior and Graduate Sections was held in February to hear a paper prepared by Mr. W. Puckey, M.I.Prod.E., F.I.I.A., entitled "Future Prospects of the Production Engineer". Due to Mr. Puckey's absence in Australia, the paper was read by Mr. G. E. Knight, the Institution's Assistant Secretary (Education and Membership). As was to be expected, this meeting attracted a large audience and provoked a very lively discussion. The display of products of the metal casting industry resulting from the use of very modern moulding and casting techniques attracted considerable comment and interest.

Luton Graduate

During January a meeting with the Luton Section of the Institution of Mechanical Engineers was held, to debate the motion, "That this house believes that a practical training is of more value to industry than an academic training".

The Annual General Meeting in March was followed by an excellent film show.

Manchester

Since the last report, three lectures have been presented to the Section, including one on "The Manufacture of Large Waterwheel Generators" by the Section President. A social evening was arranged for Friday, 20th March, at the Grand Hotel, Manchester.

With a view to "broadening the base", a Sub-Committee has been formed to consider co-operation with the cotton industry. In addition, the Section President has met members of the Cotton Board and also joined them one week-end at the Cotton Board Conference.

Manchester Graduate

In January, a lecture on "The Work of the National Physical Laboratory" was given by Mr. J. Parker, B.Sc., illustrated by a film. As Mr. A. Thompson, B.Sc., was unable to give his lecture on "Industrial Plastics and Their Application" on 18th February, a Paper was read by Mr. Dennell. Both lectures were very interesting and well attended.

Melbourne

At the March Meeting, members and visitors were very pleased to welcome Mr. Walter C. Puckey, M.I.Prod.E., F.I.I.A. Mr. Puckey was entertained to dinner by the President, Sir John Storey, and by members of the Section Committee prior to this meeting.

Mr. Puckey was officially welcomed, on behalf of members, by Sir Frederick Thorpe, who outlined Mr. Puckey's achievements and told members of the valuable work he had done for the Institution. The President then addressed members on "Industrial Productivity in Australia", after which Mr. Puckey spoke on the growth of the Institution and gave members an outline of what was being done and planned for the future by Headquarters in London. The Melbourne Section listened to Mr. Puckey with intense interest and were extremely grateful to hear a senior member of the London Council. They were all impressed by his personality, and it is felt that his visit will strengthen relations and friendship between the two countries.

North Eastern

The Section Committee are in wholehearted support of the policy of encouraging more local industrialists and others connected with the Institution to present Papers to the Section.

The Section Dinner and Dance took place on 20th February, 1933, when the function was graced by the presence of Sir Cecil Weir, President of the Institution, and Mr. W. F. S. Woodford, Secretary of the Institution. The event was well attended and tentative arrangements have been made to hold similar festive occasions during the 1953/54 and 1954/55 Sessions.

N. Ireland

The Section was honoured by a visit from Sir Cecil Weir, President of the Institution, accompanied by the Institution Secretary, Mr. W. F. S. Woodford. Sir Cecil presented an Address to a large and attentive audience in the Central Hall of the Municipal College of Technology, Belfast. To mark the occasion, an informal dinner party was held at the Royal Avenue Hotel, immediately following the Address. Several prominent local citizens, including Mr. D. A. Alexander, O.B.E., M.Sc.(Cantab), Wh.Sch., M.I.Mech.E., were invited to be present.

Nottingham

The Section has held meetings regularly each month throughout the Session. Two have been joint meetings with the Institute of Cost and Works Accountants. These meetings have now become an established procedure and have done much to strengthen the relationship between the two organisations.

Mr. R. Ratcliffe, the Sections President Elect, is now a member of the Education Committee of the Institution. Mr. T. G. H. Middleton and Mr. A. E. Stevens have joined the Section Committee.

Oxford

As the first Session of the Sub-Section's activities draws to a close, the Committee feel that they have succeeded in their primary object, which was to establish the Institution as an important facet of the educational and industrial interests in the South Midlands.

Attendances at lecture meetings have been encouraging, but there is no feeling of complacency and efforts are being made by all to increase this attendance by means of personal contacts with local undertakings and by providing a varied programme having a wide appeal.

The programme for the present Session is to be extended by the promotion of a science symposium, at which there will be a discussion on "Recent Developments in the Application of Physics, Chemistry and Engineering to Industry", led by several eminent University scientists.

Preston

The second half of the current winter programme of lectures has been successfully completed and with one exception (due to inclement weather conditions), the increase in attendance is worthy of special mention.

At the Section Annual General Meeting which was held prior to the last lecture, the President, in his Address, outlined to members the policy of "broadening the base", and he asked them to encourage senior executives of local industry to take part in the Institution activities. He appealed to members to give their earnest consideration to preparing Papers which could be presented at local lectures. Regarding the Harrogate Conference, he hoped that all who were able to do so would attend this very important function. In conclusion, he thanked the Section Committee which had so ably supported him in his first year of office.

Mr. H. Kirkman and Mr. E. G. Eaton were unanimously re-elected President and Vice-President respectively for the ensuing year. Two retiring members of the Committee, Mr. R. Thompson and Mr. H. Carleton, were re-elected and a cordial welcome was given to Mr. Watkinson, of R.o.F., Darwen, on his election.

Reading

A Summer Works Visit will definitely be held as in previous years and the Committee are considering several suggestions.

It is felt by the Committee that the Oxford Sub-Section has definite potentialities and should be granted full Section status.

Shrewsbury

The Section were pleased to welcome Mr. T. B. Worth, the Institution's Education Officer, to discuss with the Committee and local Technical College Principals the possibility of starting a Graduate Section. It was, however, disappointing to find that due to a small Student and Graduate membership it was impractical to make a start. Furthermore, it was considered that Technical Colleges in the district must first establish recognised courses to provide the desired qualifications.

South Africa

In February, a joint visit with the Institute of British Foundrymen to the recently-completed Iron and Steel Corporation Works at Van der Byl Park was arranged. The visit was well supported and over seventy members and guests were conducted by bus on a well-organised and comprehensive tour. Following this, the visitors were entertained by the Corporation to an enjoyable lunch in the Rec Club Hall.

Members of the Branch were guests of the South African Institution of Welding at a well-attended meeting held in March, at which Mr. J. H. N. Thompson, a visitor from Wolverhampton, Great Britain, delivered a Paper on "The Manufacturing Times of Welded Products".

Plans for a full-day symposium on production measurement are being prepared by Mr. V. J. F. Donnelly. It is intended that the symposium should inaugurate the new technical Session in September, 1953, after the Annual General Meeting and Dinner.

The Sub-Council are pleased to report that a marked increase has taken place in the number of students enrolling for the Production Engineering Course at the Witwatersrand Technical College.

Southern

The Section's Annual Dinner Dance was held at the Polygon Hotel on 25th March and this function was again highly successful, being attended by many local leading industrialists. The Section were very pleased to welcome Lord Sempill, A.F.C., a Past President of the Institution, on this occasion.

South Essex

During this quarter, two well-attended meetings have been held, one at Chelmsford and one at Ilford. The Paper read at Chelmsford was presented by Mr. G. Cubitt-Smith, this being the first time that a local member had read a Paper. The Annual General Meeting took place in March at Ilford.

Sydney

Following the summer recess, this year's syllabus of fixtures was opened on 3rd March, when Dr. P. Leinweber, of the Division of Industrial Development, presented a Paper entitled "The Co-relation of Practical Design and Manufacturing Tolerances". This Paper was well received by members and visitors, as was evidenced by the subsequent lengthy discussion period.

Mr. C. A. Gladman, M.I.Prod.E., has just returned from a lengthy tour of the United Kingdom, the Continent and the U.S.A., and he is scheduled to present a Paper to the Section, which should be of great interest.

Western

On 18th February, a joint meeting was held with the Bristol Branch of the Royal Aeronautical Society, when Mr. D. A. Fairnie, M.I.Prod.E., gave a most interesting lecture on "The Impact of the Gas Turbine on Aero-Engine Production Methods". All present fully appreciated Mr. Fairnie's efforts and the attendance was a measure of the members interest. The Marlborough Room was packed and "standing room only" was the order of the evening.

Western Graduate

The first meeting of the Section held in Gloucester was well attended, when Mr. B. C. Harrison presented his Paper on "Layout for Batch Production". The Brains Trust Meeting held in Bristol during February was also well attended.

On 28th March the Section organised a visit to S. Smith & Sons, Ltd., at Cheltenham, and it is hoped that this will be the successful forerunner of many more Works Visits. The Committee are now completing the details of the Garden Party to be held at the end of May, and judging by the interest shown in this project it should be a success.

Mr. B. R. Cutler has been elected Vice-Chairman of the Section.

Wolverhampton

In January, Mr. D. A. Oliver, M.Sc., presented a Paper on "The Economic Use of Materials". In February, Mr. D. Burgess spoke on "General Impressions of Automobile Production Methods gained during a Recent Visit to the U.S.A." The Annual General Meeting was held on 25th March, when the Section President, Mr. R. Beasley, together with the Section Vice-President, Mr. C. L. Old, were unanimously re-elected to office for a second year. Mr. W. J. Marshall, the Hon. Secretary has resigned and Mr. Pennant has been elected Hon. Secretary for the ensuing year.

Wolverhampton Graduate

In January, Mr. J. G. Adamson gave a lecture on "Refrigeration"; in February, Mr. J. H. Smith, F.S.A., A.F.C.I.S., gave a lecture on "Costing for the Small Engineering Firm"; and in March, a Paper on "Valid Incentives" was presented by Mr. E. C. Gordon England, M.I.Prod.E., F.I.I.A., preceded by the Annual General Meeting.

Works Visits have also been well attended. The Annual Dance was held on 20th March, 1953, in the Wulfrun Hall, Wolverhampton

Yorkshire

The Annual General Meeting was held on 9th March, when the following elections were made:

President: Mr. S. G. Haithwaite; Vice-President: Mr. D. H. Turnbull; Addition Representative to Council: Mr. F. T. Nurrish; Committee Members: Mr. L. Rigg, Mr. H. Crompton, Mr. A. Groocock and Mr. C. L. David; Hon. Secretary: Mr. J. L. Townend. After the meeting, three members of the Section, Mr. Turnbull, Mr. Rigg and Mr. Crompton, gave a very interesting Paper on "Methods of Achieving More Economic Production".

It is with regret that the resignations from the Committee of Mr. J. Hill, Mr. C. W. Mustill and Mr. J. P. Kenyon have been accepted. These members have done a tremendous amount of work for the Institution for a number of years and their presence will be missed on the Committee.

Yorkshire Graduate

The three Papers presented by Graduates for the Section President's Prize were of a high standard and the winner was presented with £3 at the Annual General Meeting on 21st March. At this meeting, Mr. W. Armstrong, M.B.E., gave a talk on "Management".

TECHNICAL STATE SCHOLARSHIPS, 1953

The Ministry of Education announces that arrangements for the award of 120 Technical State Scholarships to students from Technical Colleges and other Establishments of Further Education will be continued in 1953.

Most of the Scholarships will be offered to students who have obtained an Ordinary National Certificate or other equivalent qualifications, and will enable them to pursue full-time Honours degree or similar courses at Universities, University Colleges or Establishments of Further Education. A limited number of awards may be made to enable suitable candidates who have obtained an initial qualification by part-time study to attend approved post-graduate courses.

Full particulars of the conditions of entry and method of application may be obtained from Principals of Establishments of Further Education or from the Ministry of Education, (F.E.I.(b)), Curzon Street, London, W.1.

INSTITUTION NOTES

"CIVILIAN ASSIGNMENT"

Members will observe with special interest that among the reviews on page 293 there appears a notice of the recently-published book, "Civilian Assignment", written by Sir Cecil Weir, K.C.M.G., K.B.E., M.C.

The book is an account of the administrative achievements with which the President has been closely concerned during the past 15 years.

HALIFAX SECTION DINNER DANCE

The Halifax Section Annual Dinner Dance, which took place at the George Hotel, Huddersfield, on Friday, 27th March, 1953, was as usual a most successful and entertaining function. One of the many pleasant features was the presentation of a travelling case to Miss N. E. Bottom, Acting Section Hon. Secretary, in appreciation of her services to the Section. The presentation was made by Mr. Harold Burke, Chairman of Council, who was one of the guest speakers.

Mr. J. Blakiston, President of the Halifax Section, proposed the toast to "The Guests", among whom were, in addition to Mr. Burke, the Deputy Mayor and Mayoress of Huddersfield, the Deputy Mayor and Mayoress of Halifax, and Dr. J. E. Hurst, the well-known industrialist.

Some of the members and guests who attended the Halifax Section Dinner Dance. Among those at the top table are Mr. Harold Burke (extreme right); Mr. J. Blakiston, Halifax Section President (centre); and Miss N. E. Bottom, Acting Section Hon. Secretary (second from extreme left).

THE SIR ALFRED HERBERT LECTURE, 1953

Members are reminded that the Sir Alfred Herbert Lecture, 1953, will be presented on the 24th July, 1953, at the Sheldonian Theatre, Oxford, at 5.30 p.m. The speaker will be Sir John Cockcroft, C.B.E., F.R.S., who has chosen as his subject "Industrial Applications of Atomic Energy."

Members who wish to attend this lecture are requested to make early application to the Secretary of the Institution for tickets of admission, using the form included in the Supplement to this month's Journal.

"PROBLEMS OF AIRCRAFT PRODUCTION"

A full Report of the Southern Section Conference on "Problems of Aircraft Production", reprinted from the February/April, 1953 issues of the Journal, is now available, price 10/- per copy, post free.

Application should be made to The Secretary of the Institution, at 36, Portman Square, London, W.1.

NEWS OF MEMBERS

DR. H. SCHOFIELD, C.B.E.

Members of the Institution will be very glad to learn that Dr. Herbert Schofield, Past President, is making a steady recovery from his recent very serious illness, and hopes soon to be able to resume many of his usual activities.

MR. J. T. RYMER

Mr. J. T. Rymer, Member, has been appointed Managing Director of Sentinel (Shrewsbury) Ltd. Until recently he was Managing Director of Mirrlees Rickerton & Day, Ltd., Cheshire, and also Director of Associated British Oil Engines, Ltd; National Gas and Oil Engines, Ltd; Associated British Oil Engines Marine, Ltd., and Brush Bagnall Traction Ltd.

Mr. J. T. Rymer

Before joining the late Mr. A. P. Good's group of Companies in 1947, Mr. Rymer was Director of Blackstone & Co. Ltd., Stamford, Lincs, and also of R. A. Lister (Marine Sales) Ltd., Dursley.

MR. W. E. JEFFRIES

Mr. W. E. Jeffries, Associate Member, who is Chief Engineer with British Paints, Ltd., Newcastle-on-Tyne, is spending a few months in Trinidad, British West Indies. He is supervising the construction, plant installation and commissioning of a new paint and varnish manufacturing unit in Port of Spain, which will operate as a subsidiary to the parent company, as British Paints (Caribbean) Ltd.

MR. K. R. ADDISON

Mr. K. R. Addison, Associate Member, formerly Assistant Lecturer in Mechanical Engineering at the Norwich City College, is now Lecturer in the Mechanical Engineering Department of the College of Technology and Arts, Rugby.

Mr. K. R. Addison

Mr. Addison is well-known to members in the Norwich area for his enthusiastic and valuable services as Hon. Secretary of the Norwich Sub-Section, in the formation and development of which he has played a major part.

NEW APPOINTMENTS

Mr. G. T. Ashmole, Associate Member, has been appointed Works Manager of John Davis & Son (Derby) Ltd. Mr. Ashmole has been associated with the firm for 28 years.

Mr. G. E. Bausor, Associate Member, has been promoted to Works Manager of Cockshutt Aircraft, Ltd., Renfrew, Ontario.

Mr. A. G. Bloomer, Associate Member, is now General Manager of G. R. Turner, Ltd., Nottingham. Prior to this appointment, Mr. Bloomer was General Manager of O. Atkinson & Sons, Ltd., Harrogate.

Mr. C. Clayton, Associate Member, is now Works Manager of The Fairey Aviation Company's Research and Armament Development Division at Heston Aerodrome.

Mr. F. R. Culley, Associate Member, has been appointed Planning Engineer with Folland Aircraft, Ltd., Hamble, Southampton.

Mr. V. E. Crompton, Associate Member, is now an Engineer in the Gas Turbine Division of A. V. Roe (Canada) Ltd., Malton, Ontario.

Mr. I. Feldman, Associate Member, of Smith Meters, Ltd., has been appointed Works Manager of their Kennington factory.

Mr. R. G. Lawrie, Associate Member, has taken an appointment as Works Manager with Casemakers, Ltd., Birmingham.

Mr. R. Pagett, Associate Member, has been appointed Works Manager of Brookhirst Switchgear, Ltd., Chester.

Mr. Lance Rutter, Associate Member, of The Lapointe Machine Tool Co. Ltd., formerly the firm's Technical Representative for the Northern Territory of the British Isles, has been appointed to assist the Sales Director in Technical and Sales Representation in the Midlands and on the Continent.

Mr. C. Sumner, Associate Member, has taken the position of Manager of the Production Engineering Department at A. C. Delco, Southampton (Division of General Motors, Ltd.).

Mr. G. Thompson, Associate Member, has been appointed Director of Northern Metalife, Ltd., Greetland, near Halifax. Mr. Thompson was formerly Production Engineer with Nu-Swift, Ltd., Elland, Yorkshire.

Mr. P. J. Atkinson, Graduate, formerly of the London Graduate Section, is now living in Adelaide, and has commenced duties as Technical Assistant, Works Projects, with the Electricity Trust of South Australia.

Mr. R. S. Cracknell, Graduate, has joined Mr. F. Peacock, Management and Clothing Consultant, as a Production Engineering Consultant. Mr. Cracknell is Chairman of the Halifax Graduate Section.

Mr. R. A. Foley, Graduate, is now employed as a Technical Engineer, by the M-O Valve Co. Ltd.

Mr. A. E. Haynes, Graduate, is now Chief Draughtsman at A. B. Metal Products, Ltd., Abercynon, Glam.

Mr. W. Wilkinson, Associate Member, is now Machine Shop and Tool Room Superintendent with the Blackburn Aircraft Company, at Dumbarton.

Mr. D. L. McNamara, Graduate, is now employed as a Planning Engineer with John Inglis, of Canada.

Mr. E. Page, Graduate, is now Production Engineer, Wheel Finish Department, Carborundum Company, Ltd., Manchester.

Mr. M. J. Vivian, Graduate, was recently appointed a Technical Sales Representative with A. A. Jones & Shipman, Ltd., Leicester.

Mr. R. G. Whinfrey, Graduate, has joined Domen Co. Ltd., Industrial Building Consultants of Toronto, as Mechanical Engineer.

HAZLETON MEMORIAL LIBRARY

Members are asked to note that the Library will be open between 10 a.m. and 5.30 p.m. from Monday to Friday each week. The full facilities will not be available at the following times during this month:—

Monday,	1st June	all day.	Thursday,	11th June	all day.
Tuesday,	2nd June	all day.	Tuesday,	30th June	from 2 p.m.

It would be helpful if, in addition to the title, the author's name and the classification number could be quoted when ordering books.

REVIEWS

942.084 ENGLAND—History—World War II by Sir Cecil M. Weir. *Civilian Assignment, London, Methuen,* 1953. 182 *pages, illus.* £1 1s. 0d.

"Civilian Assignment" contains many things to interest many men. To its author, so well known and respected as President of the Institution of Production Engineers, it is "the personal story of events". To each of the many prominent men whose names figure in this book it will, I know, stir the inner recesses of the memory and bring back those many achievements shared with Sir Cecil Weir in a variety of circumstances and countries.

To me, this book is much more than a record of important events: it is, although Sir Cecil Weir would be the last to claim it, a testimony to the spirit of public service which animates so many of our countrymen, and which is present to such a high degree in the author himself.

"One gets as much out of public life as one puts in". This statement is not found by accident on the first page. It is surely a philosophy which for many years has been an essential part of his make-up and, in particular, motivates that call to action which is so characteristic of him.

I first met the author many years ago when, as a lecturer, I stepped down from the rostrum wondering, as one always does, whether the lecture had "got across" to the audience. Among the first to offer more than the conventional words was Sir Cecil Weir, and in my many later contacts with him I had many further reasons to appreciate the "personal touch" that is so strongly developed in a man who, possessing so many other qualities, is essentially human.

My admiration for his public and personal qualities grew when I later met him as Chief Executive of the Dollar Exports Board. All who served under him did so with pleasure and, let me say frankly, with a sense of difficulty in keeping up with his personal ability to enthuse, direct and achieve.

Those many members of our Institution who have met him recently will need no eulogies from me. He took over the Presidency with the same public spirit that has animated his life, and he has performed his duties with the same success, despite the fact that during his term of office he was appointed as Head of the U.K. Delegation to the European Coal and Steel Community. This appointment has necessarily kept him out of Britain for much of this time, and we have indeed been lucky that he has given so much time to the Institution's work whilst engaged on public service of such a difficult and important nature.

I am not certain whether it is necessary for me to review this book in detail. No intelligent man can fail to be greatly interested in past achievements, because they can point also to future possibilities. There is a fascinating description of

the troubles, trials, rain, yes, and sunshine experienced in organising the 1938 Scottish Exhibition. There is a pen picture of a less known and appreciated side of industrial life during the War, and to those of us who were engaged almost solely on munitions it is of great interest to realise how much Britain supported the direct war effort, first by selective export drives and, later, by finding space for munitions by concentrating other industries. These essential activities needed all the personal charm and efficiency of men like our author, and the results speak for themselves. But enough of detail. Read this book yourself and learn more of these and other fascinating pioneer work such as penicillin, the jerrican and what happened in Germany after the War.

I will make one final point, because it enables me to quote Sir Cecil again. He is, as many well know, a believer in and a backer of men, who alone make a building into an enterprise. He says—"after all, things don't just happen"—"there is always a human instrument who initiates and inspires".

We are indeed grateful to our President, who, among so many other achievements, has written this book which I hope will inspire others to "go and do likewise" in the field of public service of which he is such a distinguished member.

W.C.P.

621.74 FOUNDRY WORK

"Die Casting", by Charles O. Herb. *2nd ed. New York, Industrial Press; Brighton, Machinery Pub. Co.*, 1952. 310 *pages, illus. diags.* £1. 17s. 6d.

This book, dated 1952, was first published in 1936 and the chapter headings in the current volume are the same as those used for the first volume.

A complete description is given of die casting machines, together with their development. Detailed compositions are given for die casting alloys, including zinc, aluminium, copper, magnesium, tin, lead and cast iron.

Rather more than half the book is devoted to die design and great emphasis is laid on core design. Many examples of dies are illustrated and a chapter is devoted to standards for designing dies with the object of economising on die costs. There is a chapter on die casting of thin sections, one example having a wall thickness of approximately 0.015 ins.

Two chapters are devoted to the die casting of brass and cast iron, and the casting of aluminium bronze by the vacuum process is also described. An interesting chapter describes a unit system for die casting, whereby relatively simple interchangeable die units may be mounted in a universal holder, designed to accommodate several units, and the production may then be compared with that obtained from a multiple cavity die.

The whole book gives a reasonably complete survey of modern American pressure die casting practice. Gravity die casting is not considered since, according to American terminology, gravity casting is not included in the title.

S.R.S.

621.63 VENTILATORS: FANS

"Woods Practical Guide to Fan Engineering", ed. by W. C. Osborne and C. G. Turner. *Woods of Colchester, Ltd.*, 1952. 227 *pages, diags.* 10s. 6d.

This book is a ventilating designing reference book and will find much use in the Drawing Office or Technical Sales Department.

The book commences by discussing the conditions and requirements for a ventilating system. Next, various systems are described and recommendations made as to their best application. This section includes information concerning airflow, air distribution, cleaning, cooling, etc.

Following on, there is a comprehensive guide to duct and fan design, and information concerning noise in ventilating systems, the choice of fans and electric motor requirements.

The book concludes with 30 pages of useful information mainly in the form of tables, directly connected with ventilation.

Throughout the volume there are copious tables, charts and graphs, besides many worked examples and formulæ of the simple but very practical type.

R.E.M.

331.59 HANDICAPPED WORKERS

"Through Movement to Life: The Economic Employment of the Disabled", by John Arthur. *London, Chapman & Hall*, 1952. 93 *pages.* 7s. 6d.

There are 61,800 disabled registered unemployed. The economic employment of the disabled is a challenge to the resourcefulness of the Production Engineer faced with heavy commitments and scarcity of effective labour, while ready to hand exists an untapped source of energy capable of alleviating the burden. That such a force cannot be hitched on to the normal harness of Production Organisation is no reason for its remaining unused. The book describes an experiment, over three years, in the employment of disabled people, which proved successful as an economic productive unit, but had to be discontinued owing to the routine of industry, commerce and finance being unsuited to its fulfilment.

Part I gives factual information on the running of the scheme, the types of work undertaken and availability of markets, supervision of factory floor, costs and budgetary control. Part 2 deals with the human force, its types and capabilities, the rheumatic, deaf, physically injured, etc.

The student will gain from the book a conception of the problem from two angles, as a means of benefiting the disabled and as an available yet undeveloped force which could be adapted to economic production.

C.R.W.

OTHER ADDITIONS

679.5 PLASTICS

British Plastics Yearbook 1953: **"A Classified Guide to the Plastics Industry."** *London, Iliffe & Sons Ltd.*, 1953. 562 *pages.* £1. 10s. 0d.

British Productivity Team on Plastics Moulding. **"Plastics Moulding: Report of a . . . Team . . . which Visited the U.S.A. in 1952."** *London, British Productivity Council*, 1953. 80 *pages. Illustrated. Diagrams.* 5/6d. (Productivity Team Report.)

Du Pont De Nemours, E. I., & Co. (Inc.)—Polychemicals Dept., Wilmington, Del. **"Nylon Molding Powder."** *Wilmington, the Company*, 1952. 51 *pages. Illustrated. Diagrams.*

687 CLOTHING

British Productivity Council, London. **"Review of Productivity in the Clothing Industry."** *London, the Council*, 1953. 32 *pages.*

British Productivity Council, London. **"Review of Productivity in the Hosiery Industry."** *London, the Council*, 1953. 33 *pages.* 1/-.

914.2 GREAT BRITAIN—Directories

"Engineer Buyers' Guide." 1953 *ed. London, The Engineer.* 606 *pages.* 5/-.

Industrial Association of Wales and Monmouthshire, Cardiff. **"Industrial Directory of Wales and Monmouthshire."** *2nd ed. Cardiff, the Association*, 1952. 340 *pages. Illustrated.* 10/6d.

914.94 SWITZERLAND

"Swiss Technics." General Index of the Swiss Machine Tool Industry. *Lausanne, Swiss Office for the Development of Trade*, 1952. 62 *pages.* (Special Supplement to No. 2, 1952 of **"Swiss Technics."**)

Switzerland — Office of Industrial Information. **"Directory of Machines, Apparatus and Tools, 1952."** *19th ed. Geneva, the Office*, 1952. 1392 *pages. Illustrated.* £2. 1s. 0d.

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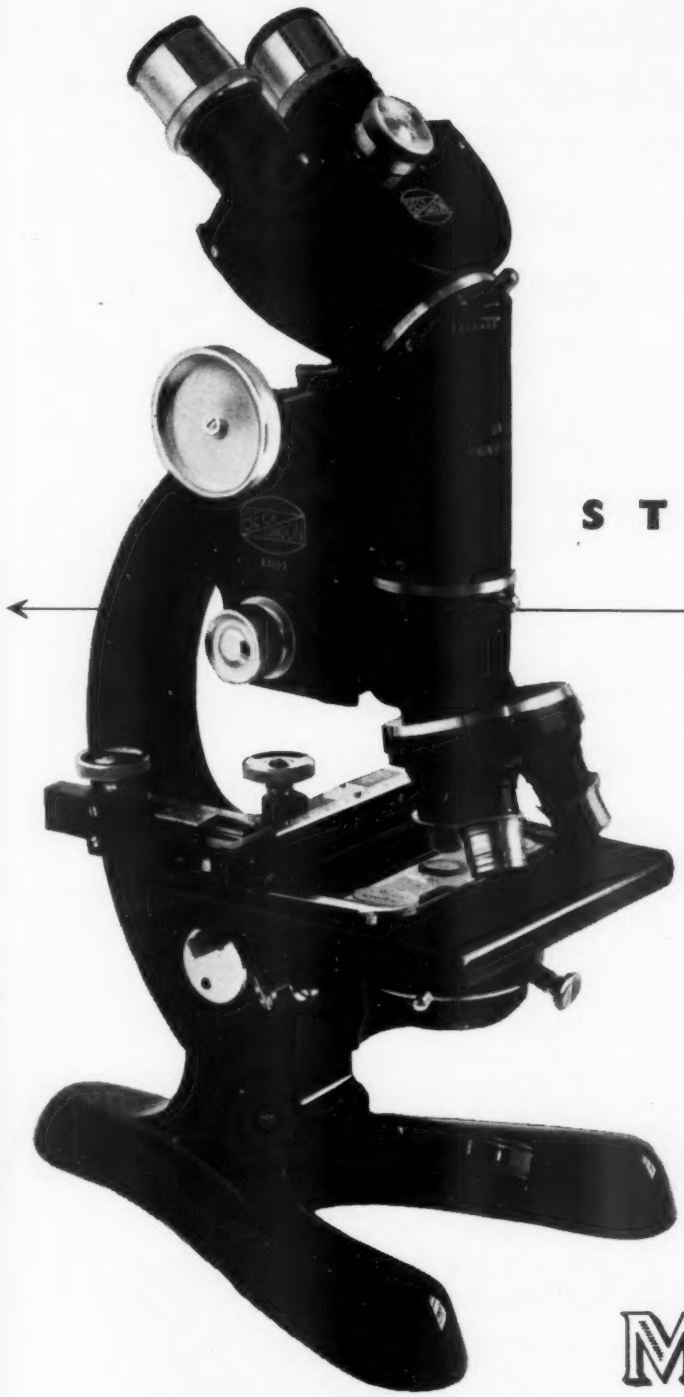

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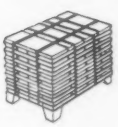

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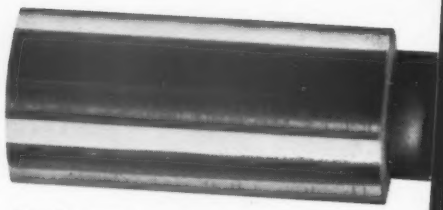

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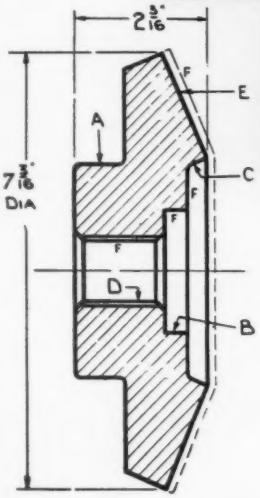

DESCRIPTION OF OPERATION	Tool Position		Spindle Speed R.P.M.	Surface Speed Ft. per Min.	Feed Cuts per inch
	Hex.Turret	Cross-slide			
Chuck on A	—	—	—	—	—
Rough Face End	—	S.T.1	240	260	93
Rough Bore B	1	—	500	260	Hand
Recess Bore C	2	—	240/35	240/35	Hand
Chamfer Bores	3	—	700	690	Hand
Finish Bore B and Bore D	4	—	1000	525	270
Rough Angle Face E	—	S.T.2	240	450	133/Hand
Finish Angle Face E (2 cuts)	5	Rear	240/350	450/650	93/133
Tap 1⅛" × 14 T.P.I	6	—	70	20	14
Chamfer O/dia.	—	S.T.2	70	130	Hand
Remove	—	—	—	—	—

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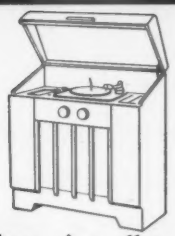

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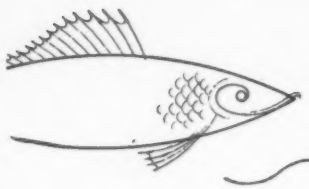

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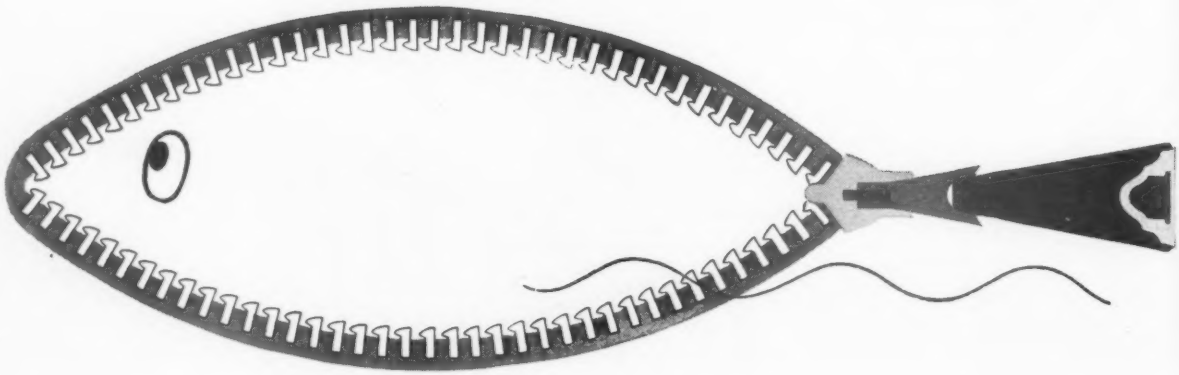

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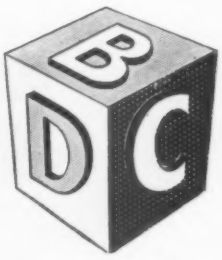

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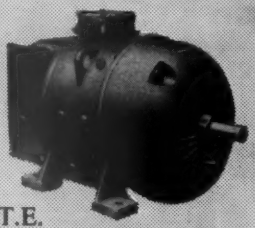
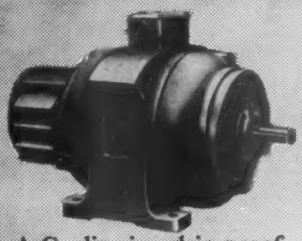
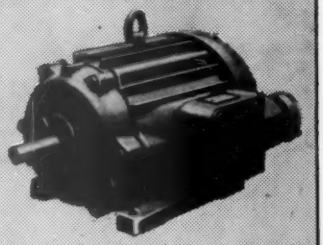


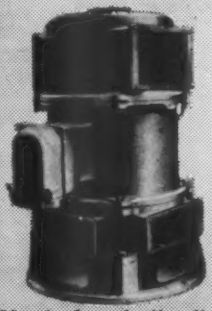
T.E. fan-cooled D.C. motor



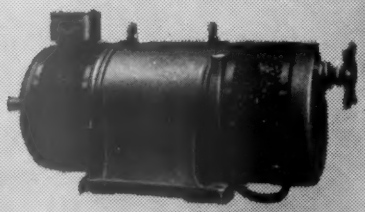
A.C. slip-ring drip-proof motor.



T.E. fan-cooled squirrel-cage flameproof motor.



Vertical spindle slip-ring induction motor



A.C. variable-speed commutator-motor

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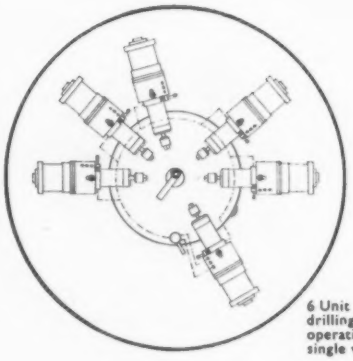
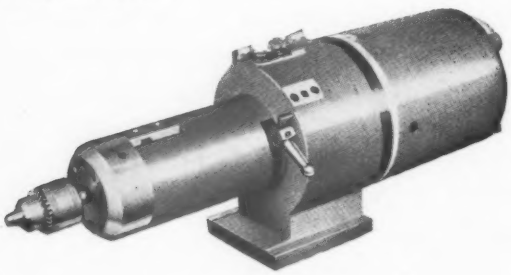


6 Unit Drilling Machine drilling six holes in one operation controlled by single valve.



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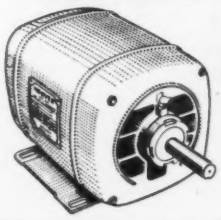

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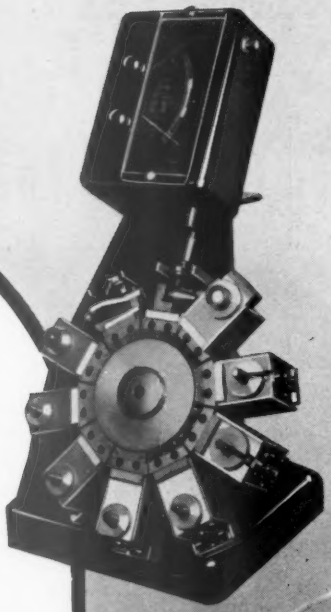

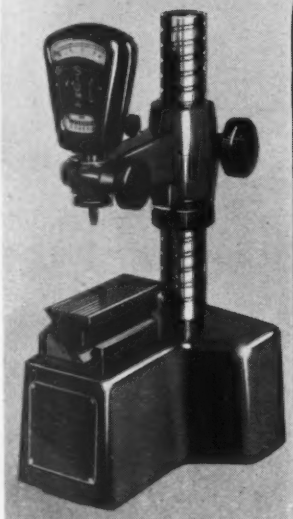

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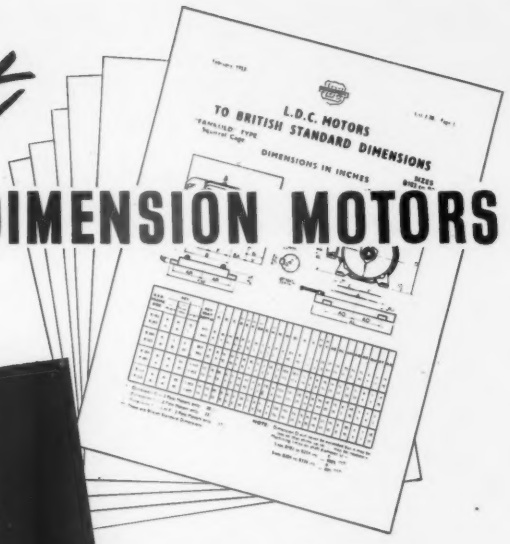

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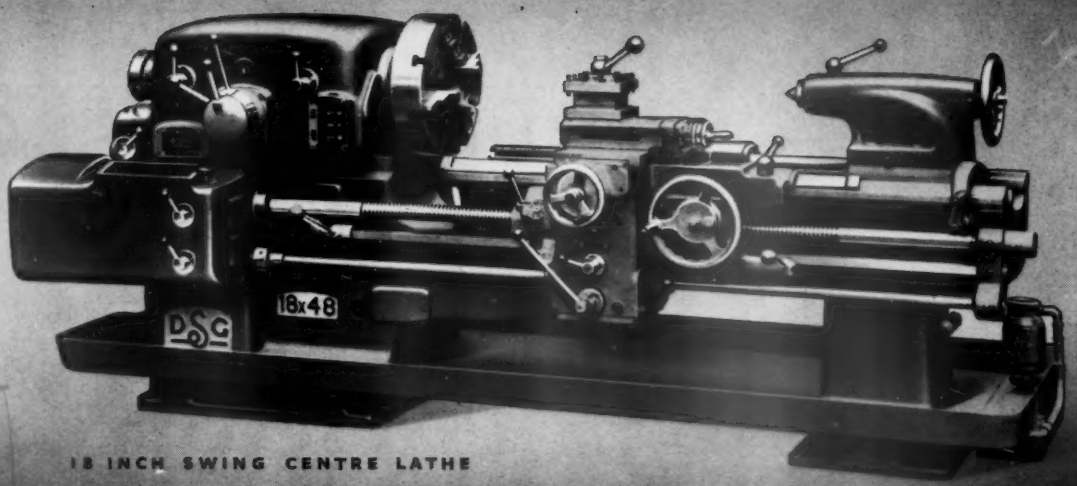

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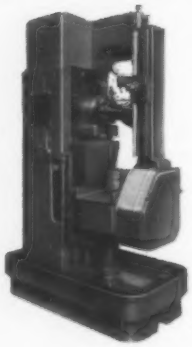
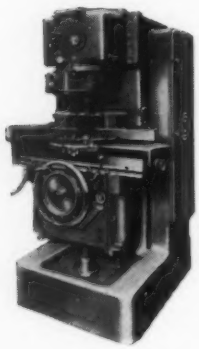
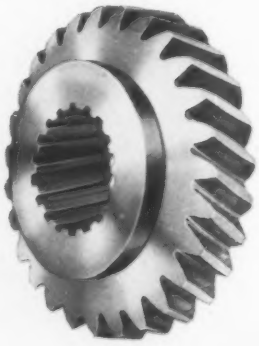


Shaving

CHURCHILL RED-RING DIAGONAL GEAR SHAVER



A typical example of accurate production . . .



COMPONENT: Automobile Gear—27 teeth—9·25 N.D.P. Helix Angle 26°—13ft.—15in. Face Width ⅜in.

HOBBING: 3·5 minutes.

SHAVING: 40 seconds. Removing ·002/3in. from each flank.

SOUND TESTING: 40 seconds.

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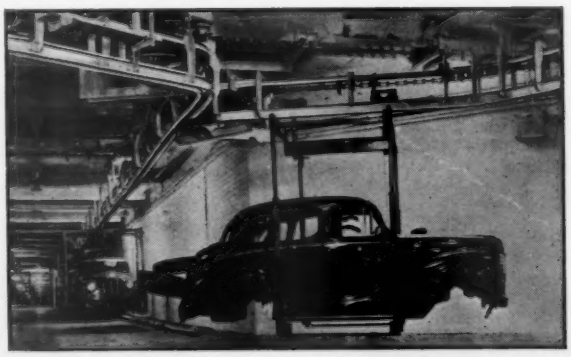
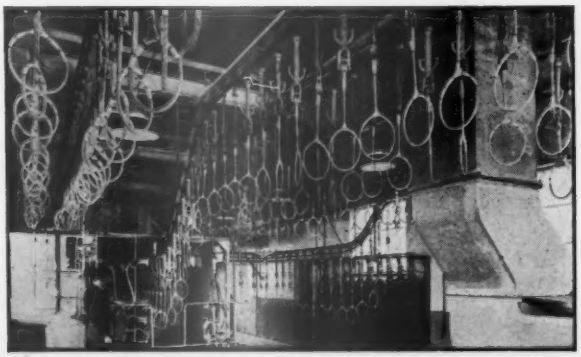
CONVEYORS



An Austin body goes on a KING Dual-Duty Conveyor to meet its chassis; part of the famous installation at Longbridge — 16 miles of conveyor in all.



Tennis racquets on a KING Power-Pulled Junior Conveyor at Dunlop's Waltham factory. A very different problem from motor bodies — but the results are pleasantly alike — smooth production, lower costs.

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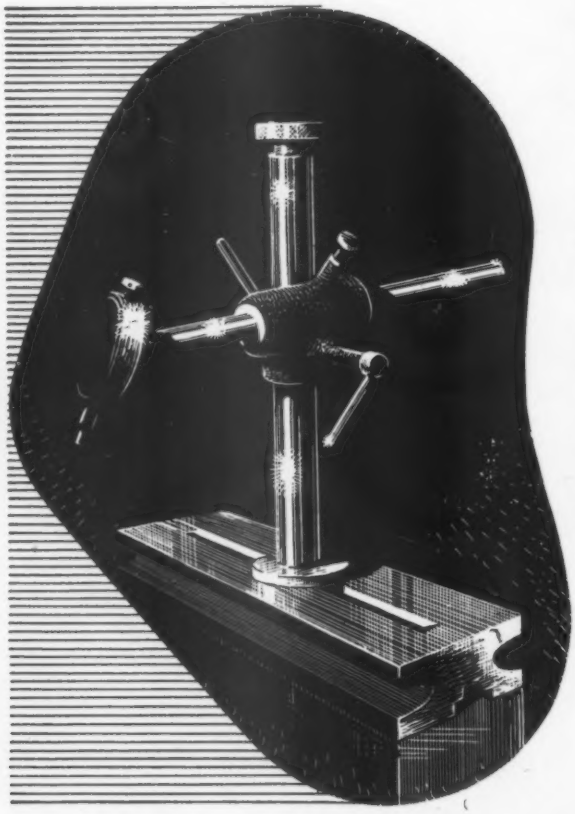

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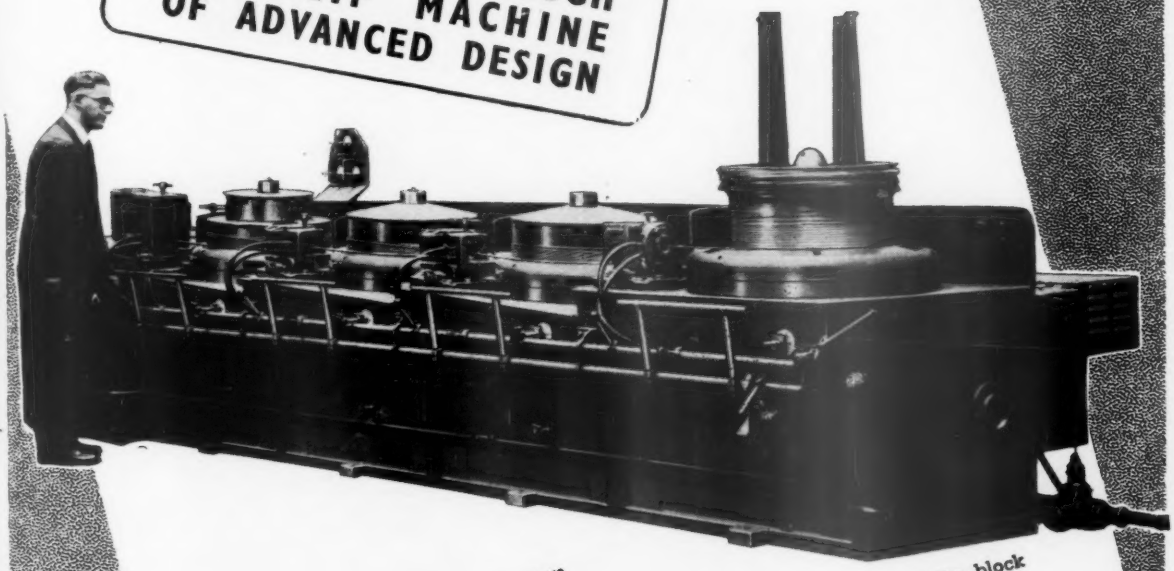

Special 4/5 Block Pathfinder Type 22/40 for drawing mild steel from 5 s.w.g. at speeds up to 2,250 feet per minute.

1. The wire passes straight through the machine from block to block. The block speeds are automatically regulated by our patented electrical gear. Wire tension between blocks can be independently set.
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3. Almost infinite drafting can be obtained at each die.
4. The machine is ideal for use with a heavy spooler carrying up to about two tons of finished wire.
5. Owing to the absence of all guide pulleys, multi-holing from very heavy inlets is perfectly feasible.
6. Standard SIX BLOCK machines are available for high carbon or mild steel as follows:—

	Type 22/30	Type 22/40
Block Diameter.	22"	22"
Maximum inlet.	.250"	.3125"
Finish.	.120"—.072"	.156"—.080"
Drawing Speeds Ft/Min.	800—1600	700—1400

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MR. 52

The illustration above shows castings which have been pressure die cast in aluminium and "Mazak" zinc alloys

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They are A.S.T.A. certified for breaking capacities up to and including 250 MVA at 6.6 and 11kV.
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Unit construction ensures easy extension, while all parts of similar pillars are interchangeable.
Circuit breakers and oil switches can be arranged in any combination.
'ENGLISH ELECTRIC' type OLX circuit breakers are designed for safe and consistent operation, for reliability under all conditions of service with the minimum initial cost.

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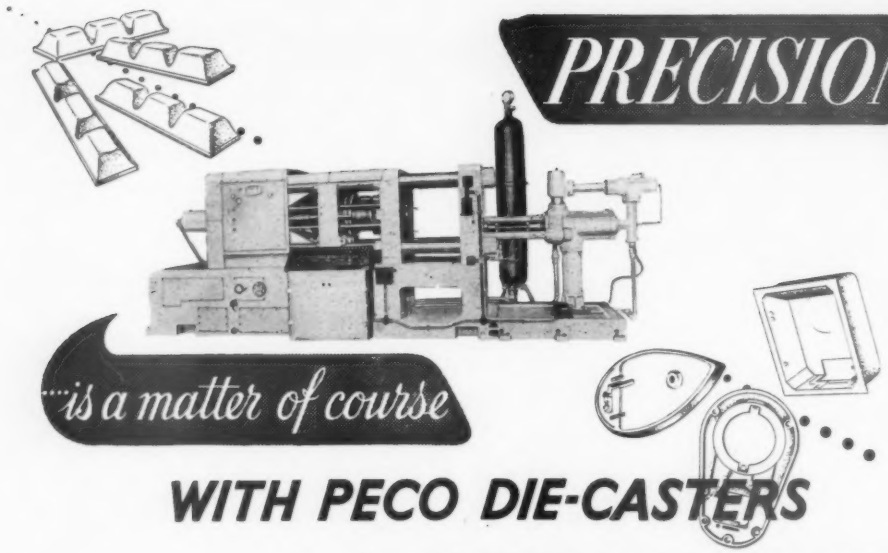

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ELECTRICAL SEQUENCE CONTROL

The new PECO Cold Chamber Die-Caster has modernised the technique of cold-chamber die-casting, producing castings that are clean and accurate in dimension, reducing the need for further machining to a minimum.

Largely contributing to this result is the Electrical Control—a unique PECO feature—which covers every movement of the cycle and ensures continuity and uniformity of production.

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ROTARY DRUM METAL PARTS CLEANING MACHINE

SIZE '00'

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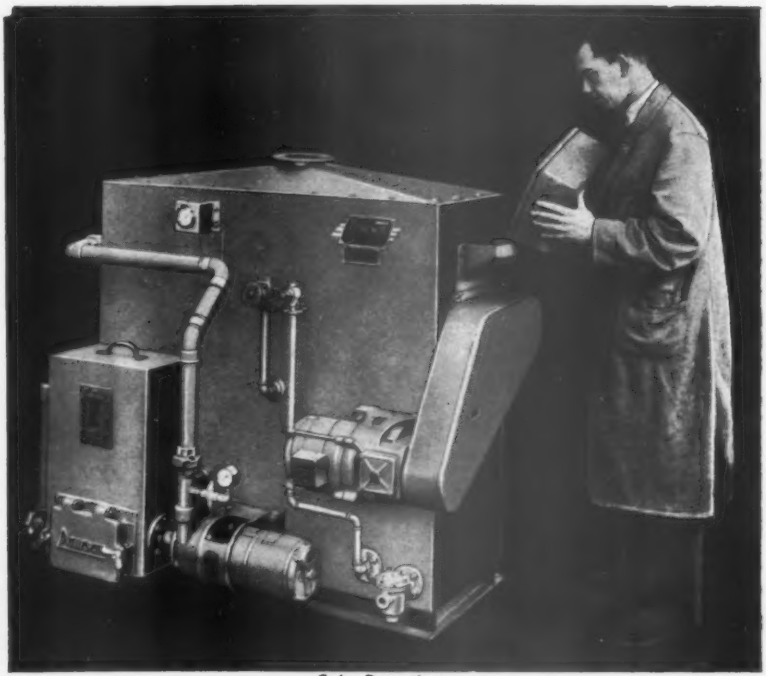

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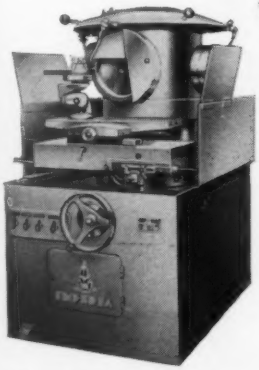
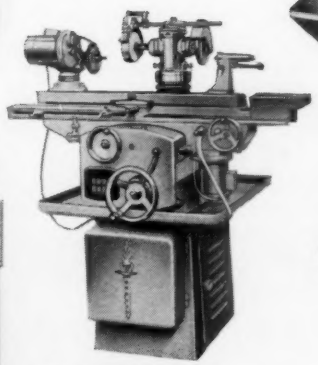
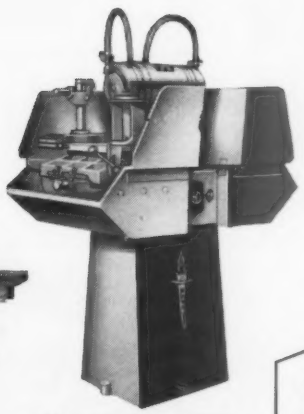


① ROTARY HEAD CARBIDE TOOL GRINDER, Type MO 14



② UNIVERSAL TOOL AND CUTTER GRINDER, TYPE M6 AR



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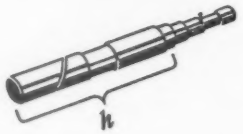

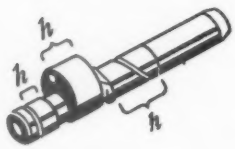

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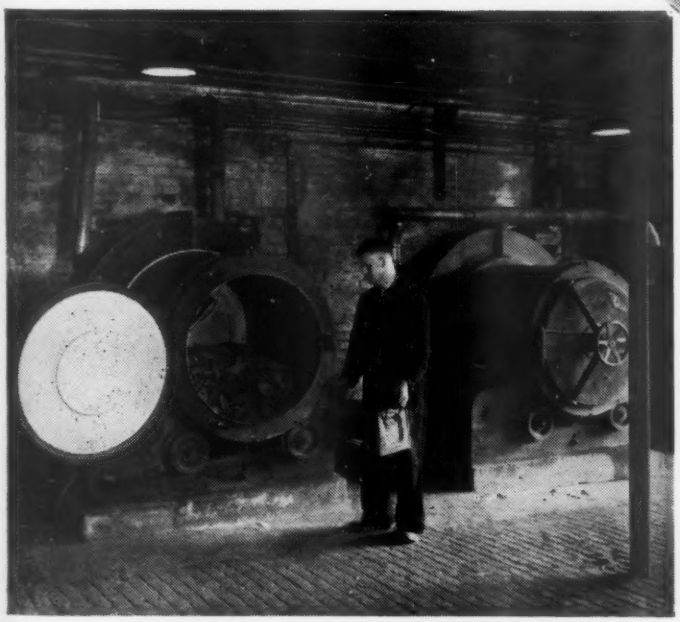

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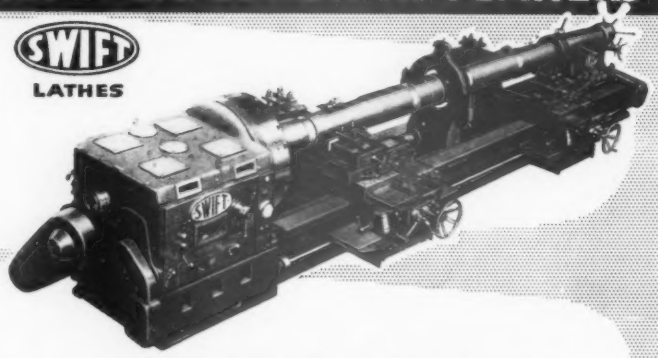

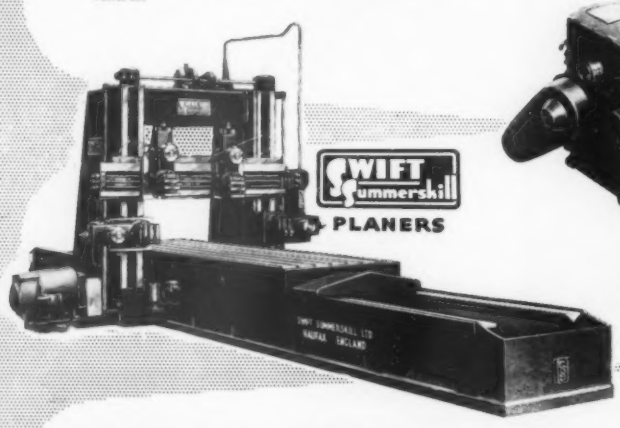

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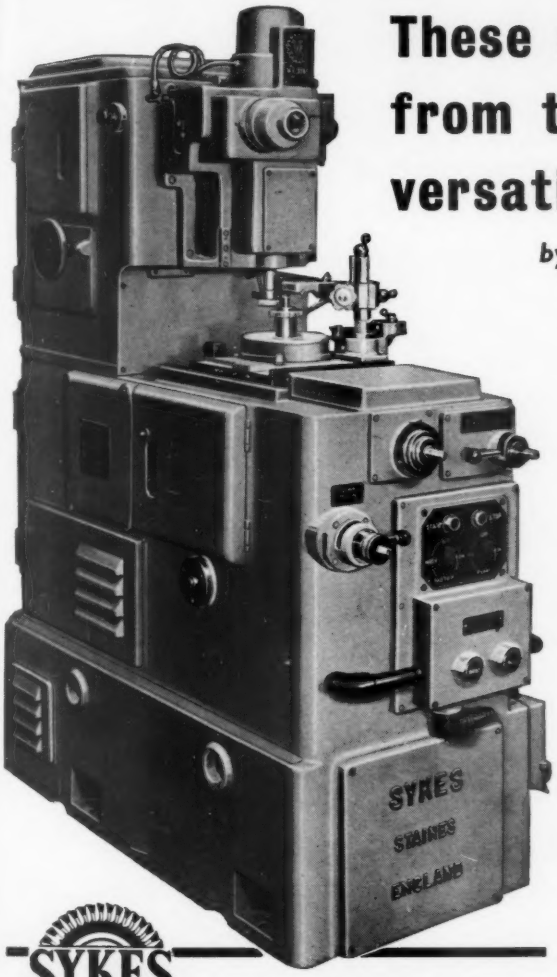

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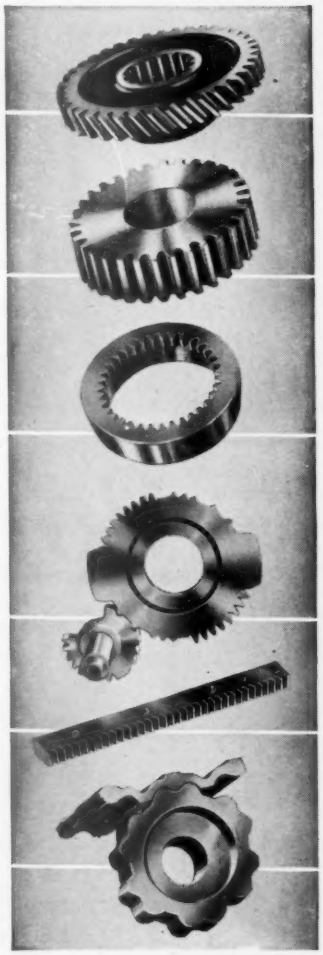

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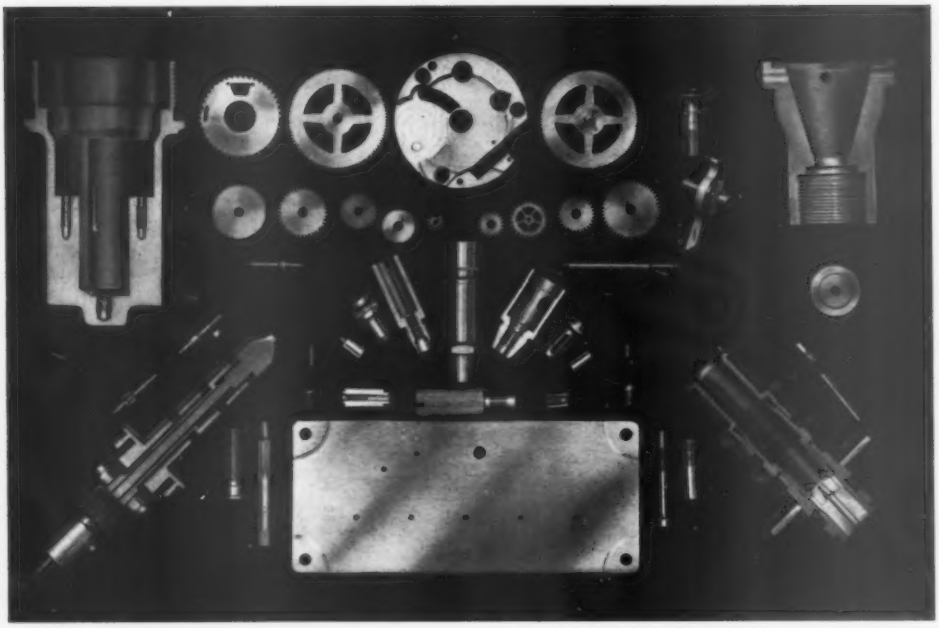

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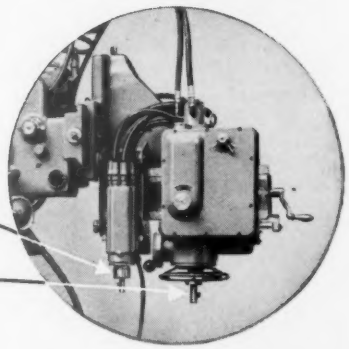

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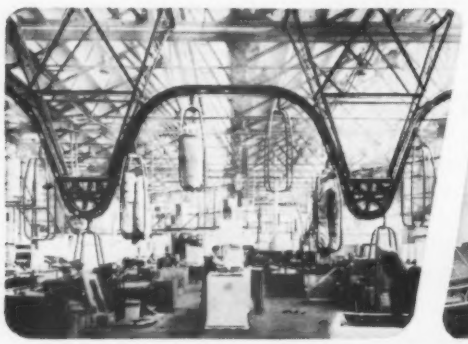

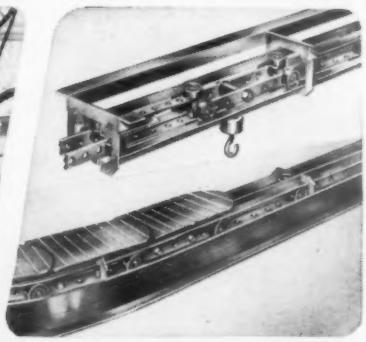

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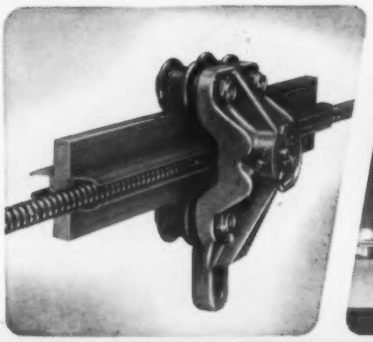

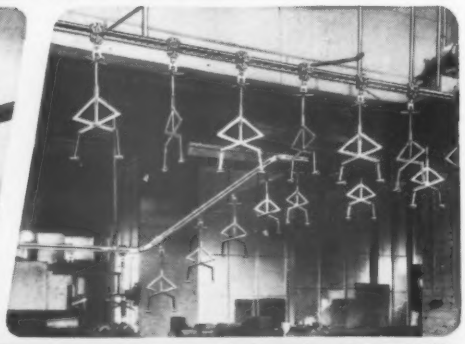

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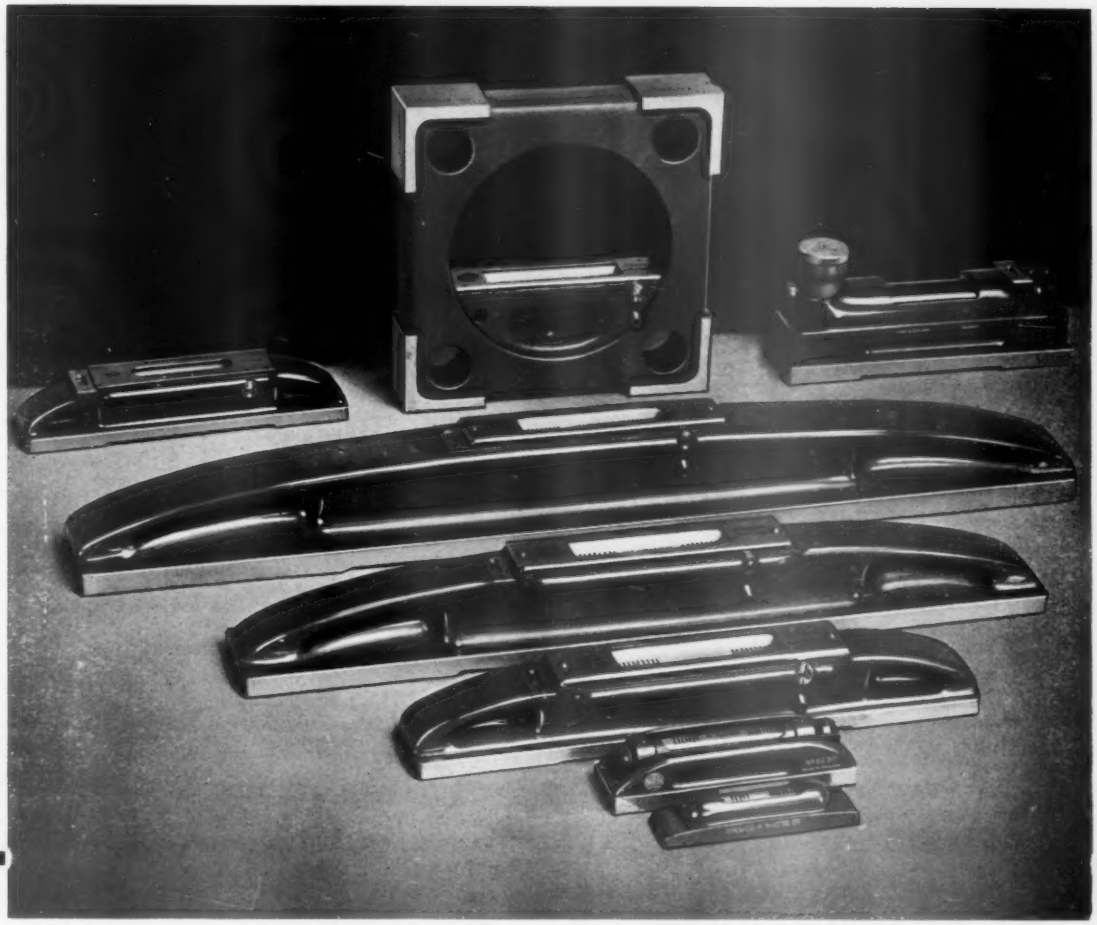

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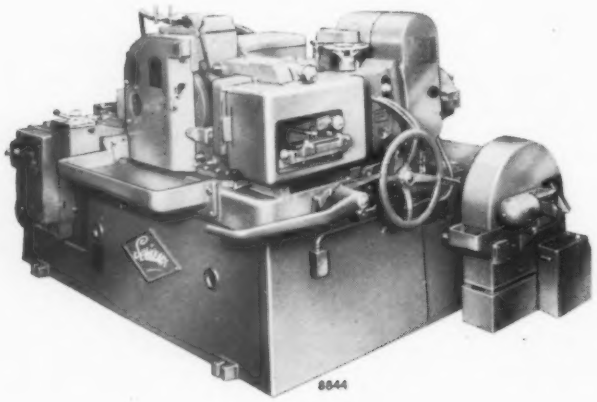

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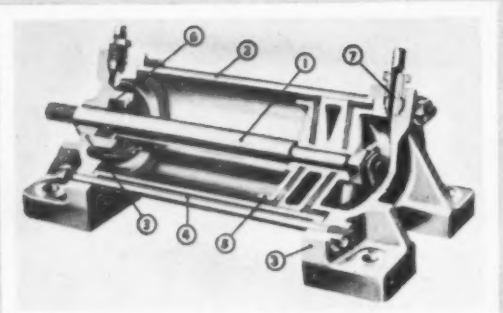

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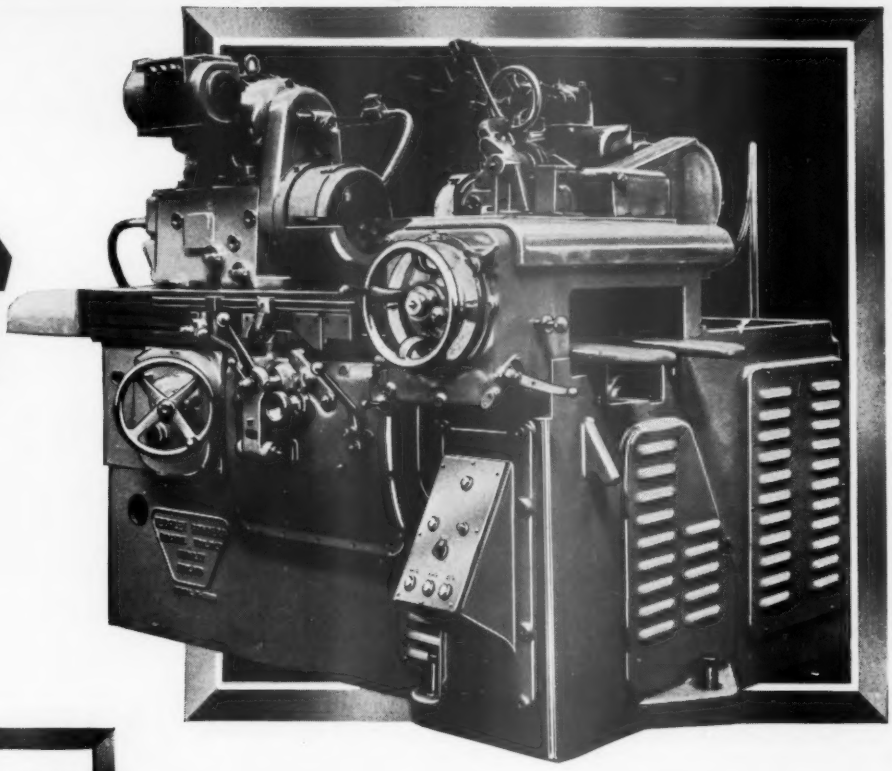

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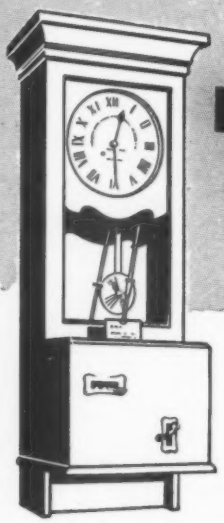

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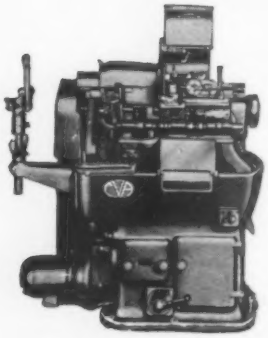

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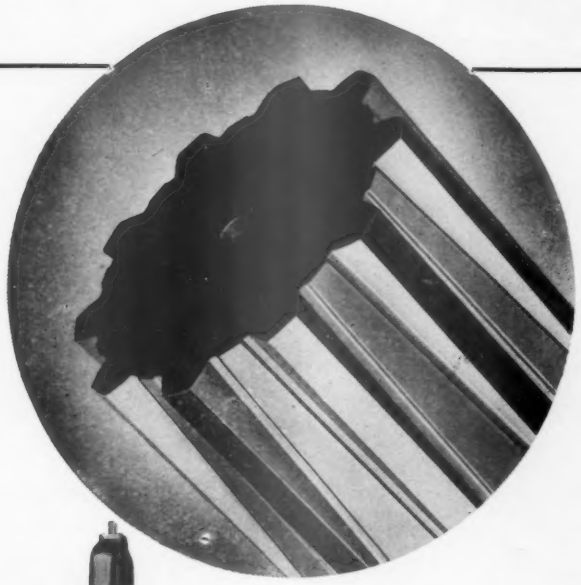

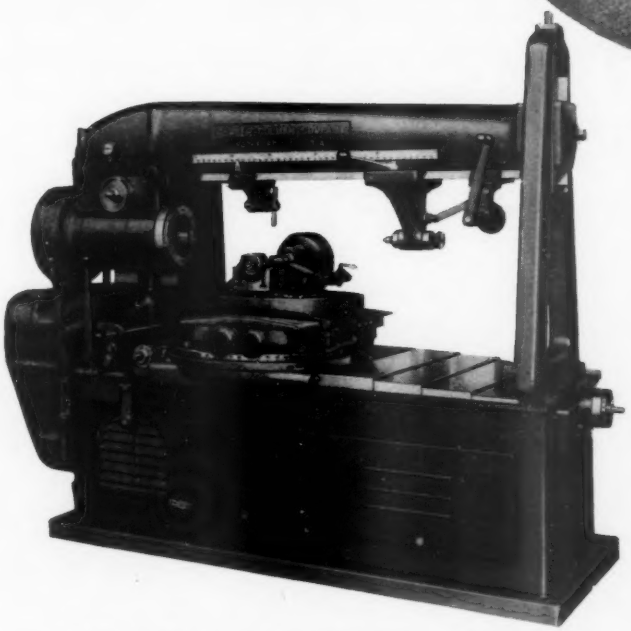

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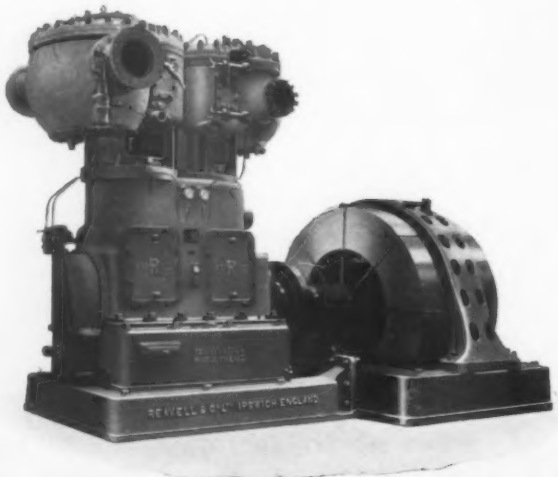

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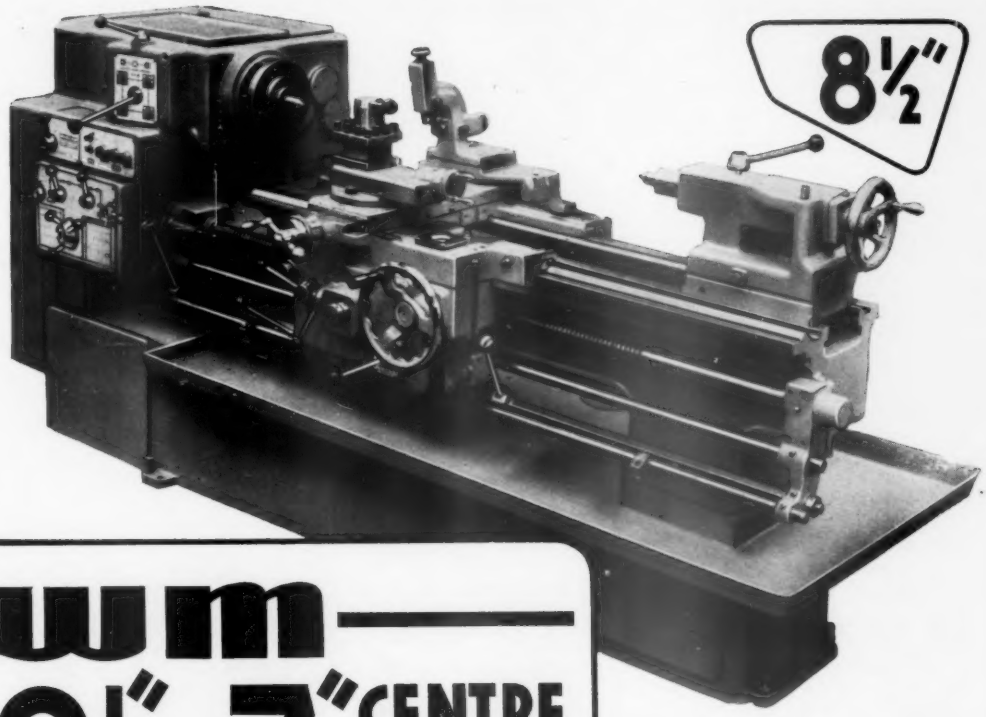

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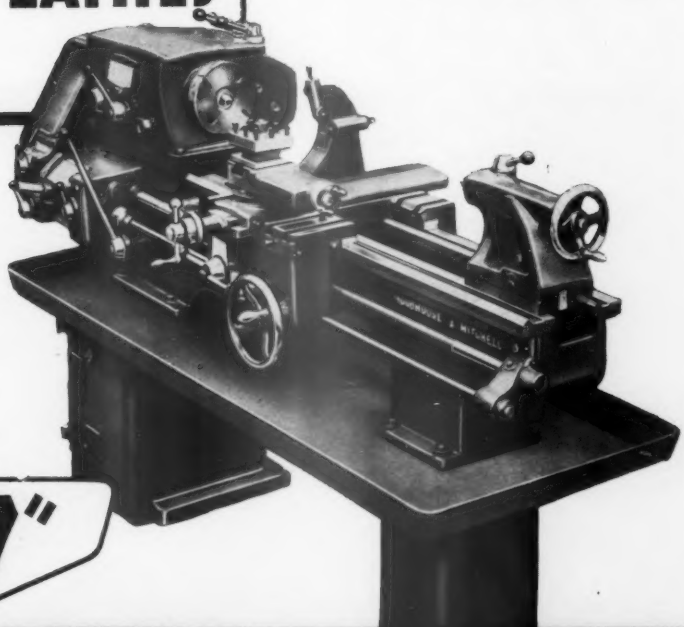

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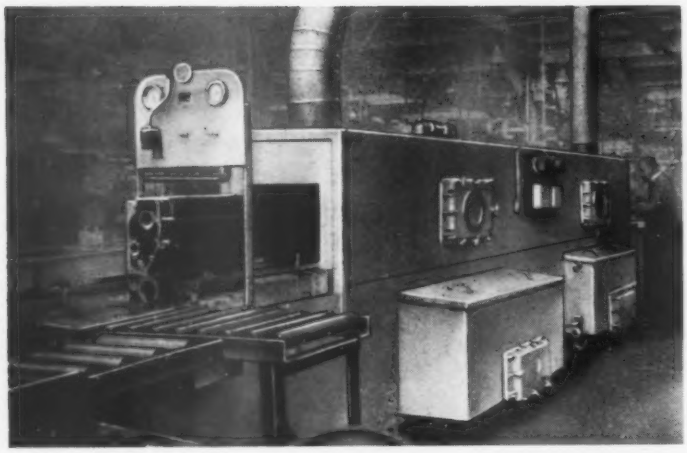

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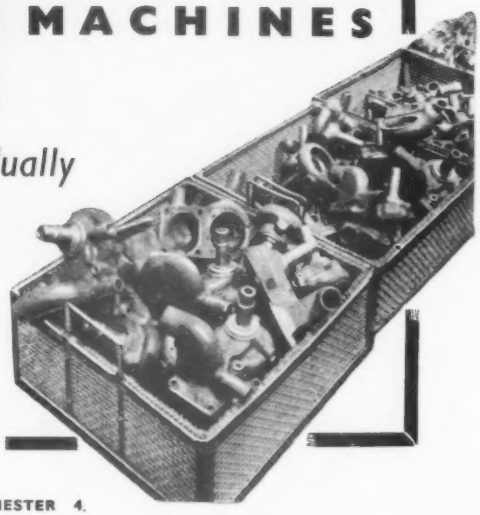

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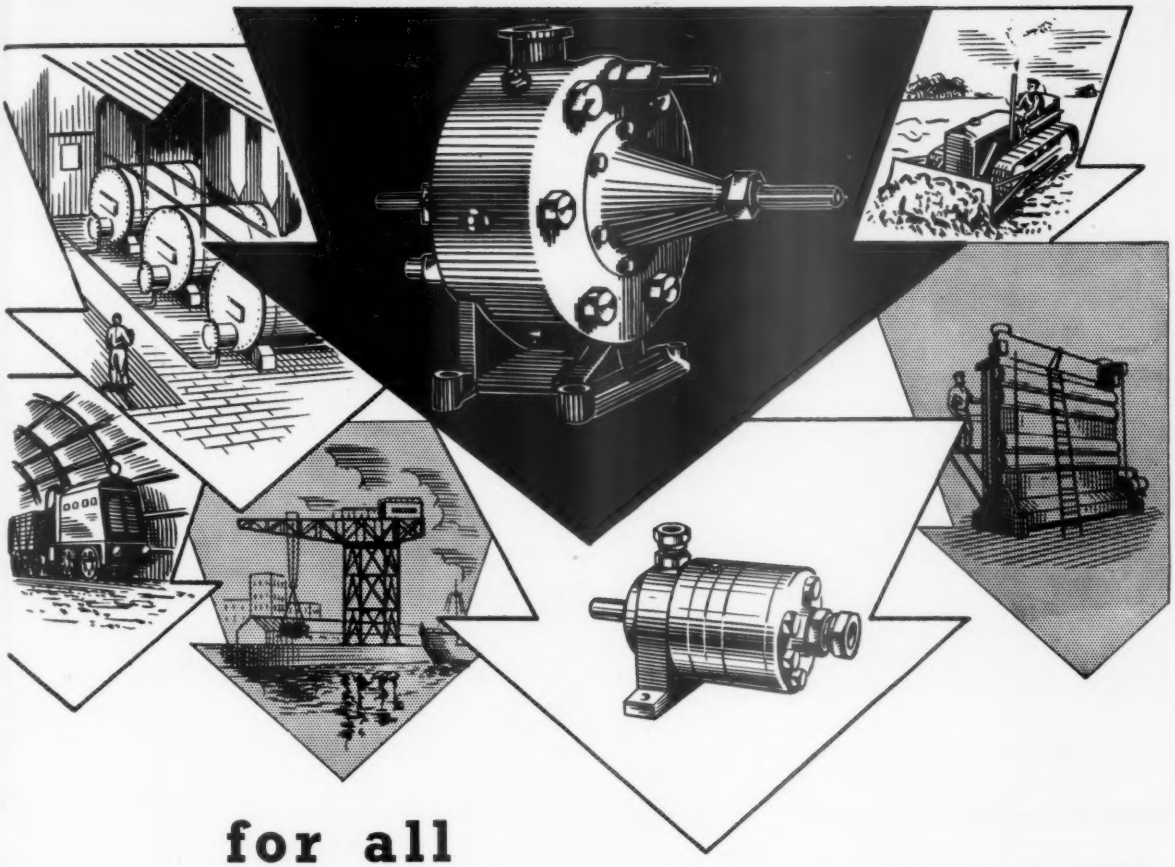

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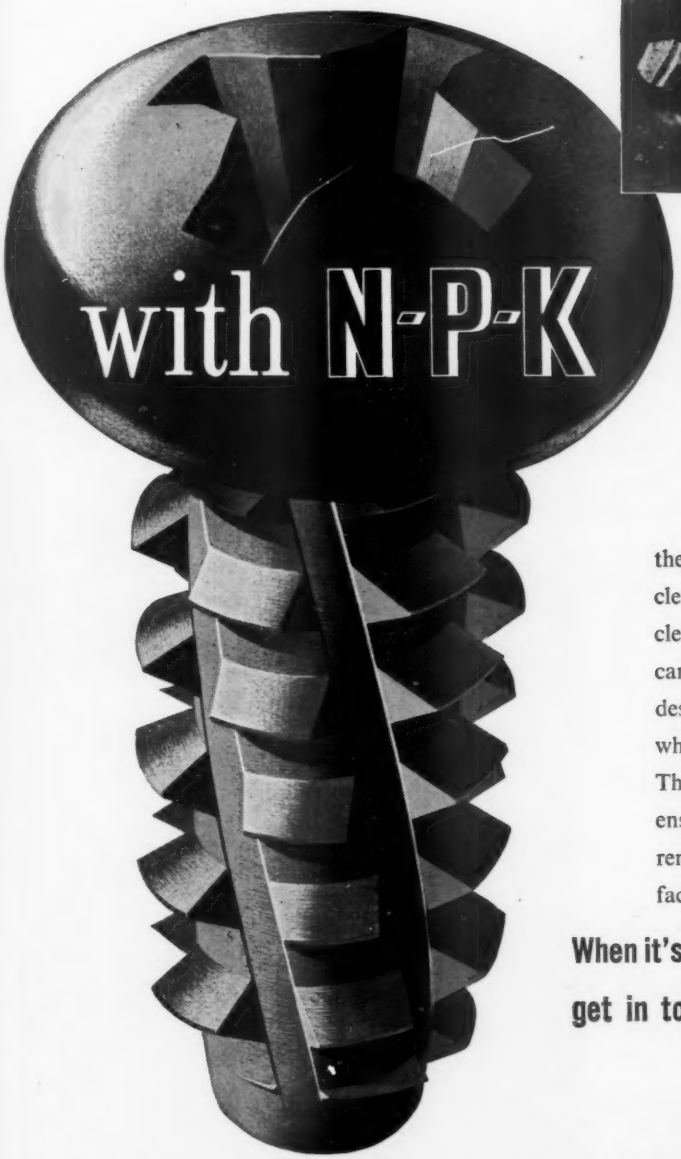

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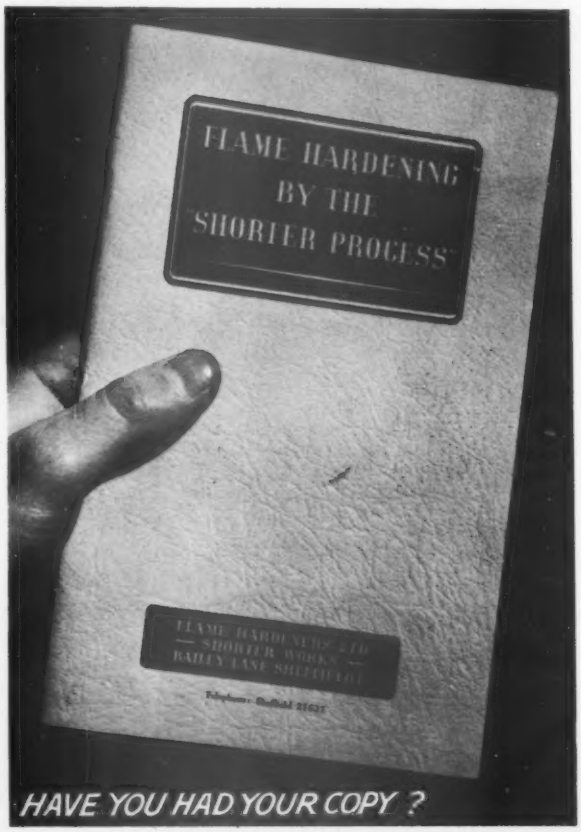

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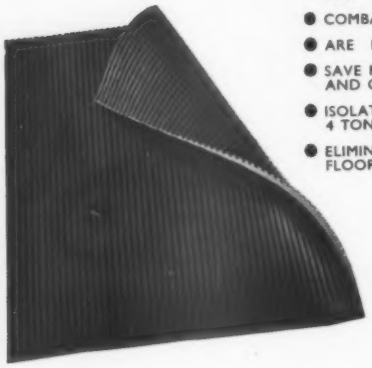

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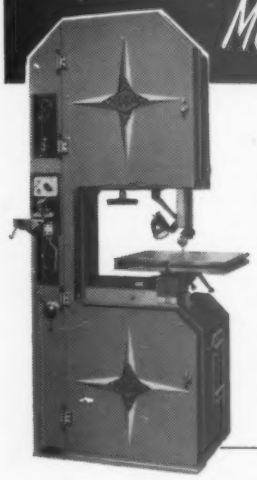

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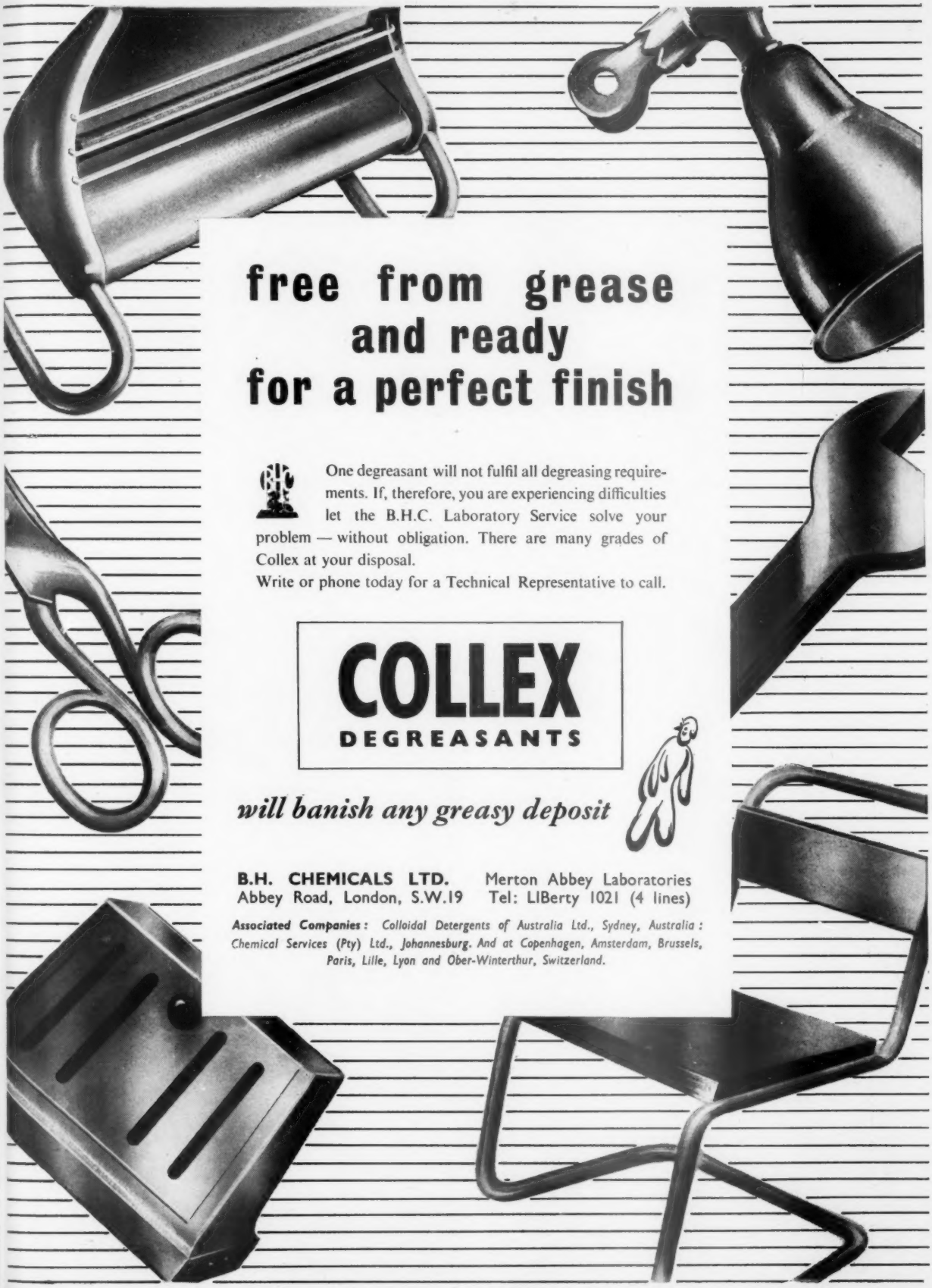

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INDEX TO ADVERTISEMENTS

	Page
Accles & Pollock, Ltd.	Lxx
Accles & Shelvoke, Ltd.	Lxxiv
Adam Machine Tool Co., Ltd.	Lvi
Allen, Edgar & Co., Ltd.	xiv
Andrews, Harold, Grinding Co., Ltd.	—
Asquith, William, Ltd.	xxii
Automatic Coil Winder & Electrical Equipment Co., Ltd.	iv
Barber and Colman, Ltd.	Lxiii
Birlec, Ltd.	L
Birmingham Aluminium Casting (1903) Co., Ltd.	iii
Block and Anderson, Ltd.	Liv
Bratby and Hinchcliffe, Ltd.	Lxvi
Bray, George, & Co., Ltd.	Lvi
British Aero Components Ltd.	v
British Die Casting and Engineering Co., Ltd.	xxviii
British Electrical Development Association	xxxviii
B.H. Chemicals, Ltd.	Lxxiii
British Industrial Plastics, Ltd.	—
British Tabulating Machine Co., Ltd.	—
British Thomson-Houston Co., Ltd.	xxxi
Brooks and Walker, Ltd.	Lxxii
Broom and Wade, Ltd.	—
Brown, David, Machine Tools, Ltd.	x
Catmur Machine Tool Corporation, Ltd.	xxxii
Central Tools Equipment Co., Ltd.	Lviii
Churchill, Charles & Co., Ltd.	xl
Churchill Machine Tool Co., Ltd.	xxvi
Cincinnati Milling Machines, Ltd.	Lvii
Climax Rock Drill & Eng. Works Ltd.	xi
Cohen, George, Sons, & Co., Ltd.	xLix
Cossor, A. C., Ltd.	—
Coventry Gauge and Tool Co., Ltd.	—
Dawson Bros., Ltd.	xLviii
Dean Smith and Grace, Ltd.	xxxix
Designex (Coventry), Ltd.	Lxxii
Donovan Electrical Co., Ltd.	—
Drummond-Asquith (Sales), Ltd.	xxiii
Drummond Bros., Ltd.	vi
Dyson and Co., Enfield (1919), Ltd.	—
E.M.B. Co., Ltd.	—
English Electric Co., Ltd.	xLv
English Steel Corporation Ltd.	—
Firth Brown Tools, Ltd.	ix
Firth, Thos., & Brown, John, Ltd.	—
Fisher and Ludlow, Ltd.	Lxxi
Flame Hardeners, Ltd.	Lxx
Fox, Samuel, & Co., Ltd.	—
Fraser, Andrew, & Co., Ltd.	Lxvii
Fraser & Glass, Ltd.	viii
Gledhill-Brook Time Recorders, Ltd.	Lxii
G.P.A. Tools and Gauges, Ltd.	xLii
Guest, Keen & Nettlefolds (Midlands), Ltd.	Lxix
Guylee, Frank, and Son, Ltd.	L
Harrison, T. S., and Sons, Ltd.	—
Harris Tools, Ltd., John	Lxviii
Herbert, Alfred, Ltd.	xxxv
Hilger and Watts, Ltd.	Lix
Holbrook Machine Tool Co., Ltd.	xvii
Holman Bros., Ltd. *Outside Back Cover*	
Hoover, Ltd.	xxxiii
Horden, Mason and Edwards, Ltd.	—
Hunt, A. H. (Capacitors), Ltd.	xLvi
Imperial Smelting Corporation (Sales), Ltd.	xix
Impregnated Diamond Products, Ltd.	xxxvi
Johansson, C. E., Ltd.	xii
Jones, E. H. (Machine Tools), Ltd.	xLvii
Jones, Sidney G., Ltd.	xiii
King, Geo. W, Ltd.	xLi
Lancashire Dynamo and Crypto Ltd.	xxxvii
Lancing Machine Tools, Ltd.	—
Lang, John, and Sons, Ltd.	xxiv
Lang Pneumatic Ltd.	Lx
Lapointe Machine Tool Co., Ltd.	—
Lloyd, Richard, Ltd.	—
Lund, John, Ltd.	xvi
Machine Shop Equipment, Ltd.	—
Machinery Publishing Co., Ltd.	—
Marbaix, Gaston, E., Ltd.	xx, xxi
Marshall-Richards Machine Co., Ltd.	xLiii
McGraw-Hill Publishing Co., Ltd.	Li
McKechnie Bros., Ltd.	Lii
Melbourne Engineering Co., Ltd.	Lxii
Metropolitan-Vickers Electrical Co., Ltd.	—
Midland Saw & Tool Co., Ltd.	Lxxii
Mollart Engineering Co., Ltd.	—
Monks and Crane, Ltd.	vii
Myford Engineering Co., Ltd.	—
Neil, James, and Co. (Sheffield), Ltd.	Lxiv
Newall, A. P., and Co., Ltd.	Lxviii
Newall Group Sales, Ltd.	Lxi
Park Gate Iron and Steel Co., Ltd. *Inside Back Cover*	
Parkinson, J., and Son (Shipley), Ltd.	—
Paterson Hughes Engineering Co., Ltd.	—
Power Jacks, Ltd.	Lii
Powers - Samas Accounting Machines (Sales), Ltd.	xxix
Press Equipment Co.	—
Projectile and Engineering Co., Ltd.	xLviii
Pryor, Edward, and Son, Ltd.	—
Radio Heaters Ltd.	—
Raglan Engineering Co. (Nottingham), Ltd.	—
Ransomes, Sims, and Jefferies, Ltd.	—
Reavell and Co., Ltd.	Lxiv
Redfern's Rubber Works, Ltd.	—
Reliance Gear & Eng. Co. (Salford), Ltd.	—
Riley, Robert, Ltd.	Lxvi
Russell, S., and Sons, Ltd.	—
Scrivener, Arthur, Ltd.	Lx
Selson Tool Co., Ltd.	—
Shell Mex and B.P., Ltd.	—
Sparklets, Ltd.	Lxx
Spencer and Halstead Ltd.	Liii
Sunbeam Anti-Corrosives, Ltd.	xxxiv
Swift, Geo., and Son, Ltd.	Liv
Sykes, W. E., Ltd.	Lv
Tecalemit, Ltd.	xxx
Teleflex Products Ltd.	Lviii
T.I. Aluminium Ltd.	—
Turner Machine Tools Ltd.	—
Unbrako Socket Screw Co., Ltd.	xv
United Steel Companies, Ltd	—
Van Moppes and Sons (Diamond Tools), Ltd.	—
Vulcascot (Great Britain), Ltd.	Lxxii
Ward, H. W., and Co., Ltd.	xxv
Ward, Thos. W., Ltd.	Lxv
Wickman, Ltd.	xviii
Wild Barfield Electric Furnaces, Ltd.	—
Winn, Chas., and Co., Ltd.	—
Wolverhampton Die Casting Co., Ltd.	xLiv
Zinc Alloy Die Casters Association	xxvii

urnal

push
y and

djust-
rtical

CE

6
56

Page

LXIV
LXVIII
LXI

Cover

—

—
LII

XXIX
—

XLVIII
—

—

—
—
LXIV
—

—
LXVI
—

LX
—

—
LXX
LIII
XXXIV
LIV
LV

XXX
LVIII
—

—

XV
—

—
LXXII

XXV
LXV
XVIII

—
—

XLIV

XXVII